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BUREAU OF PUBLIC WORKS

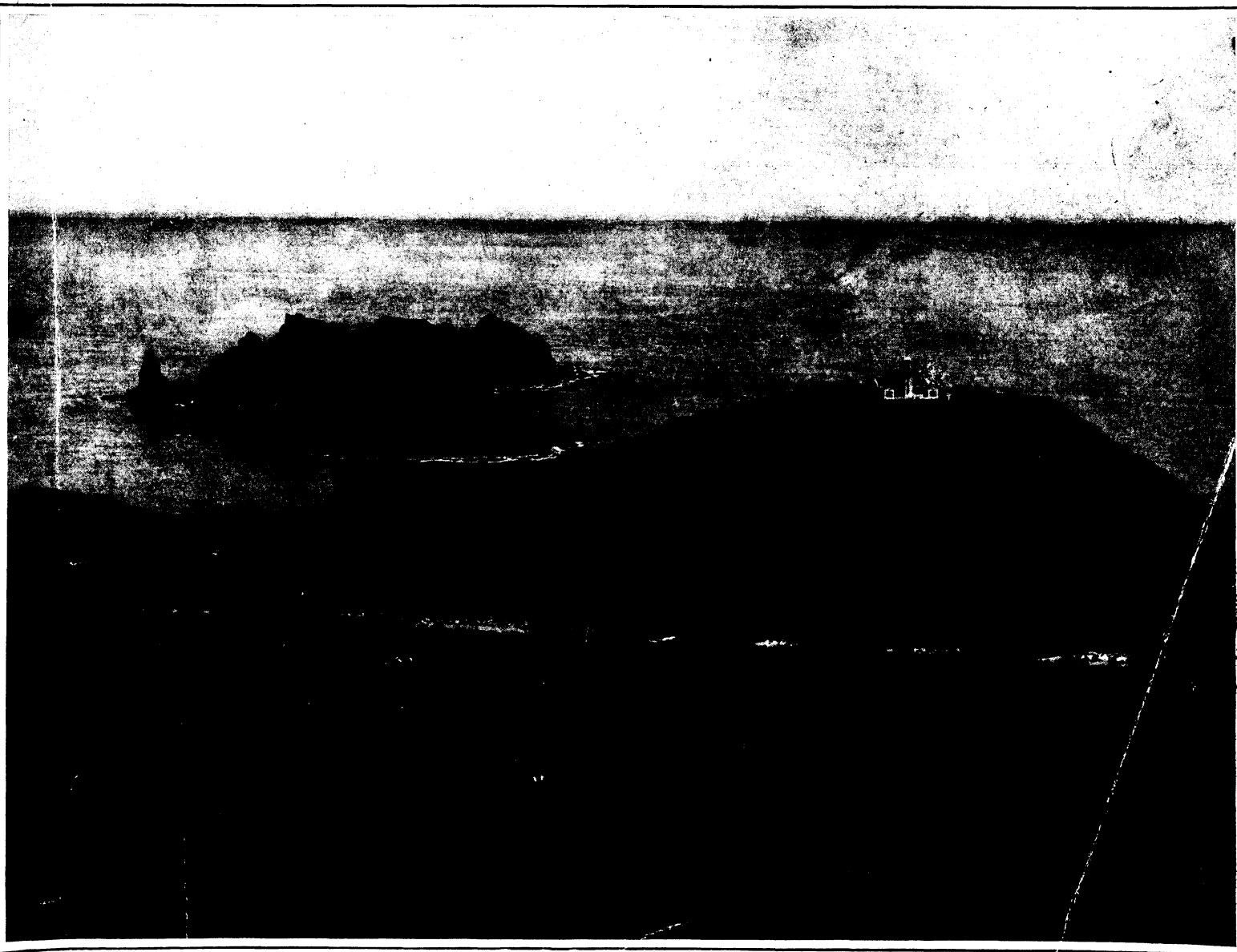


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QUARTERLY BULLETIN

BUREAU OF PUBLIC WORKS
MANILA, P. I.

ISSUED QUARTERLY BY
THE CONSTRUCTING DIVISION, UNDER THE DIRECTION OF
THE DIRECTOR OF PUBLIC WORKS

C. A. TANSILL, COMPILER OF STATISTICS

The objects of the QUARTERLY BULLETIN are:

1. To show each engineer and employee of the Bureau of Public Works the work of the Bureau as a unit.
2. To show him that his work is a unit part of the whole.
3. To make clear to every provincial and municipal official and to the people the work being done by the Bureau.
4. To make the work of the Bureau of personal interest to all.

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PORT WORKS AND LIGHTHOUSE CONSTRUCTION IN THE PHILIPPINE ISLANDS.

By K. S. HECK,
Member, American Society of Civil Engineers.

[See title-page for first-order light.]

At very few places in the world, comparatively speaking, are port and harbor improvements and lighthouses of greater importance than in the Philippine Islands.

The Archipelago consisting of more than 3,000 separate islands, the chief routes of transportation and commerce will obviously remain for all time by water.

Fortunately, the islands are fairly well provided with harbors of refuge, where within a few hours' run from any given point a vessel may find protection from the disastrous typhoons that frequently visit the northern and eastern portions of the Archipelago during certain seasons of the year; but the products of the country being almost entirely from the soil, bulky and heavy and easily damaged by water, can be economically loaded upon and discharged from ships only by means of modern port facilities.

The importance of such improvements is capable of at least approximate computation and expression in dollars and cents.

When the first improvement of the port of Cebu (of which the writer was at the time engineer in charge) was nearing completion, and a portion of the work had been opened to the commerce of the port, data was secured from all the leading importers and exporters as to the cost of loading and discharging cargo by the old method, viz, by lighter, and by the new method where vessels moored alongside the new sea wall and loaded and discharged by ships' tackle directly from and to the new quay or "Muelle."

The figures so obtained naturally varied somewhat according to

the length of haul from landing place to the various warehouses, but after making due allowance for such conditions the net results were practically uniform.



Cebu wharf, front view.

The total quantities of cargo handled were then secured from the customhouse records and the results are tabulated below:

Savings in handling charges effected at the port of Cebu by the construction of the new sea wall in 1908.

Article.	Foreign.		Coastwise.		Total.
	Imports.	Exports.	Inward.	Outward.	
	Tons.	Tons.	Tons.	Tons.	Tons.
Rice.....	37,915			35,700	73,615
Baled hemp.....		26,463			26,463
Loose hemp.....			24,600		24,600
Copra.....		17,235	16,900		34,135
Sugar.....	16,401		15,500		31,901
All others.....	9,251	81	41,000	36,980	87,312
Total.....	47,166	60,180	98,000	72,680	278,026

Article.	Handling charges.		Saving per ton.	Total saving per annum.
	By lighter.	By wharf.		
Rice.....	P1.25	P0.65	P0.60	P44,169.00
Baled hemp.....	1.60	.56	1.04	27,521.52
Loose hemp.....	3.20	1.12	2.08	51,168.00
Copra.....	1.25	.65	.60	20,481.00
Sugar.....	1.20	.70	.50	15,950.50
All others.....	1.65	.80	.85	74,215.20
Total.....				233,505.22

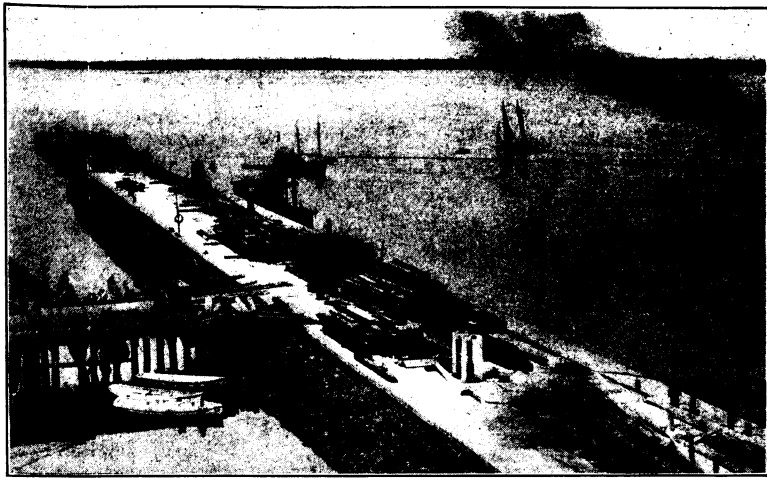
The above tabulation does not take into consideration the additional savings effected by the reduction in losses due to theft and the wetting of cargo handled by lighter, both of which items were practically eliminated, and which, from data furnished by the importers and exporters, was conservatively estimated at 1 per cent of the value of all cargo handled, or an average of P1.43 per ton, which, if added to the saving of P0.84 in handling charges, shows a total saving of P2.27 on every ton of cargo handled over the new quay.

The port of Cebu, even before its improvement, being fairly well protected from heavy monsoon seas, was more favorably located for the handling of cargo by lighter than most of our smaller ports are to-day. Labor was plentiful, and with a comparatively large commerce, the unit cost of maintaining the required floating plant was very low.

In view of these facts it is estimated that the unit saving at Cebu is somewhat less than the average that might be effected were all our ports equally well improved.

From the annual report of the Insular Collector of Customs for the fiscal year ending June 30, 1913, we find that approximately 540,000 tons of hemp, sugar, copra, tobacco, etc., were exported from the Islands, and a little more than 1,000,000 tons of miscellaneous cargo imported during the year.

As none of our open ports are the natural outlets for the richest producing districts of the Islands, and accordingly serve chiefly as transshipping ports, the bulk of our products are collected by interisland vessels from the hundreds of secondary ports to which



Cebu Wharf, rear view showing portion of coral rock dyke for retaining backfill.

the producing districts are tributary, carried thence to one of the open ports, where they are discharged, finally loaded upon the foreign vessels in which they are exported to foreign lands.

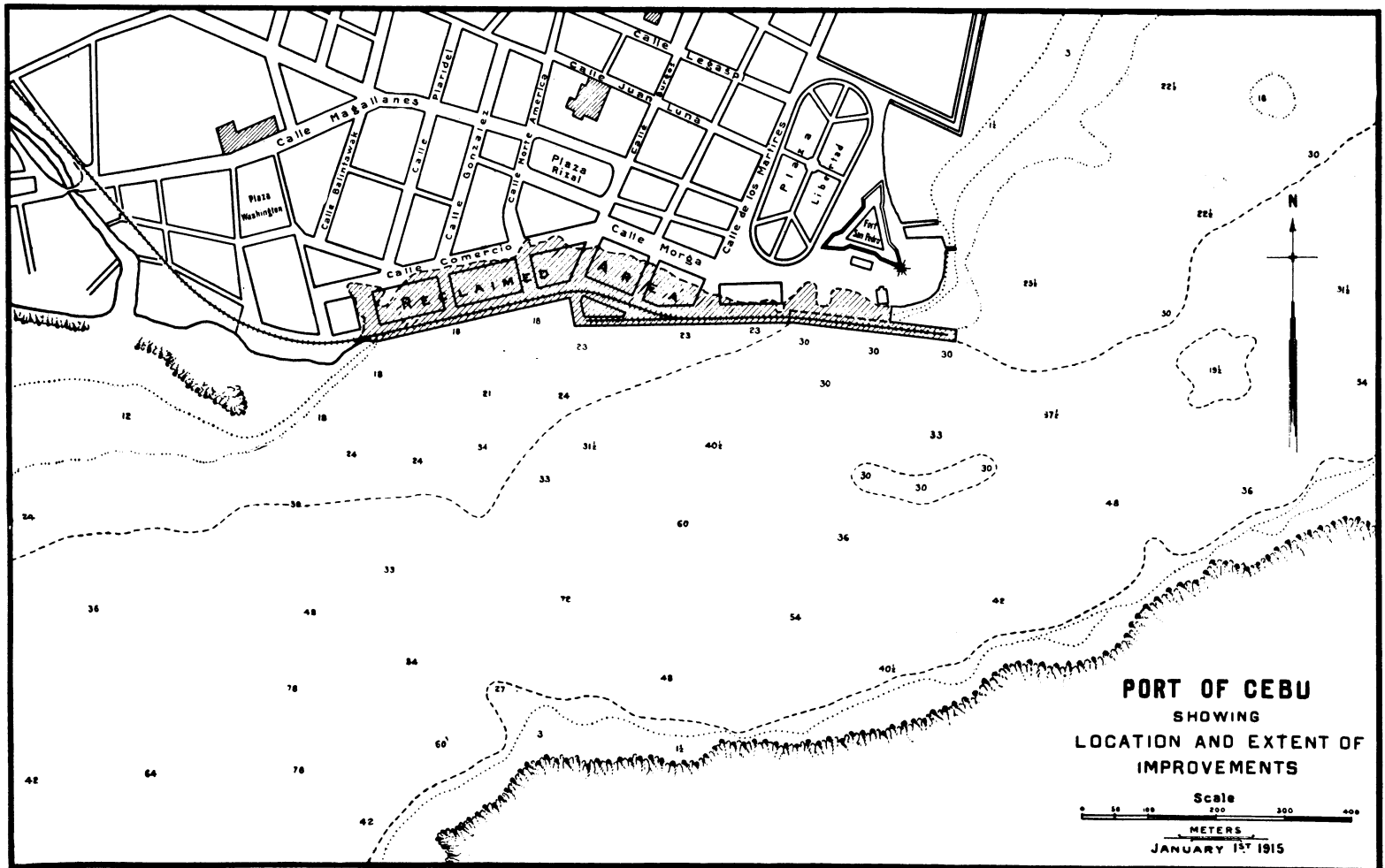
the consumer; or in other words, at the present time we annually load or discharge more than 3,500,000 tons of cargo.

Applying the figures obtained at Cebu, which if anything are below rather than above the average, we find that the entire absence of port improvements would to-day levy an annual toll of more than ₱7,945,000 on the commerce of the Islands.

Of scarcely less importance is our lighthouse system.

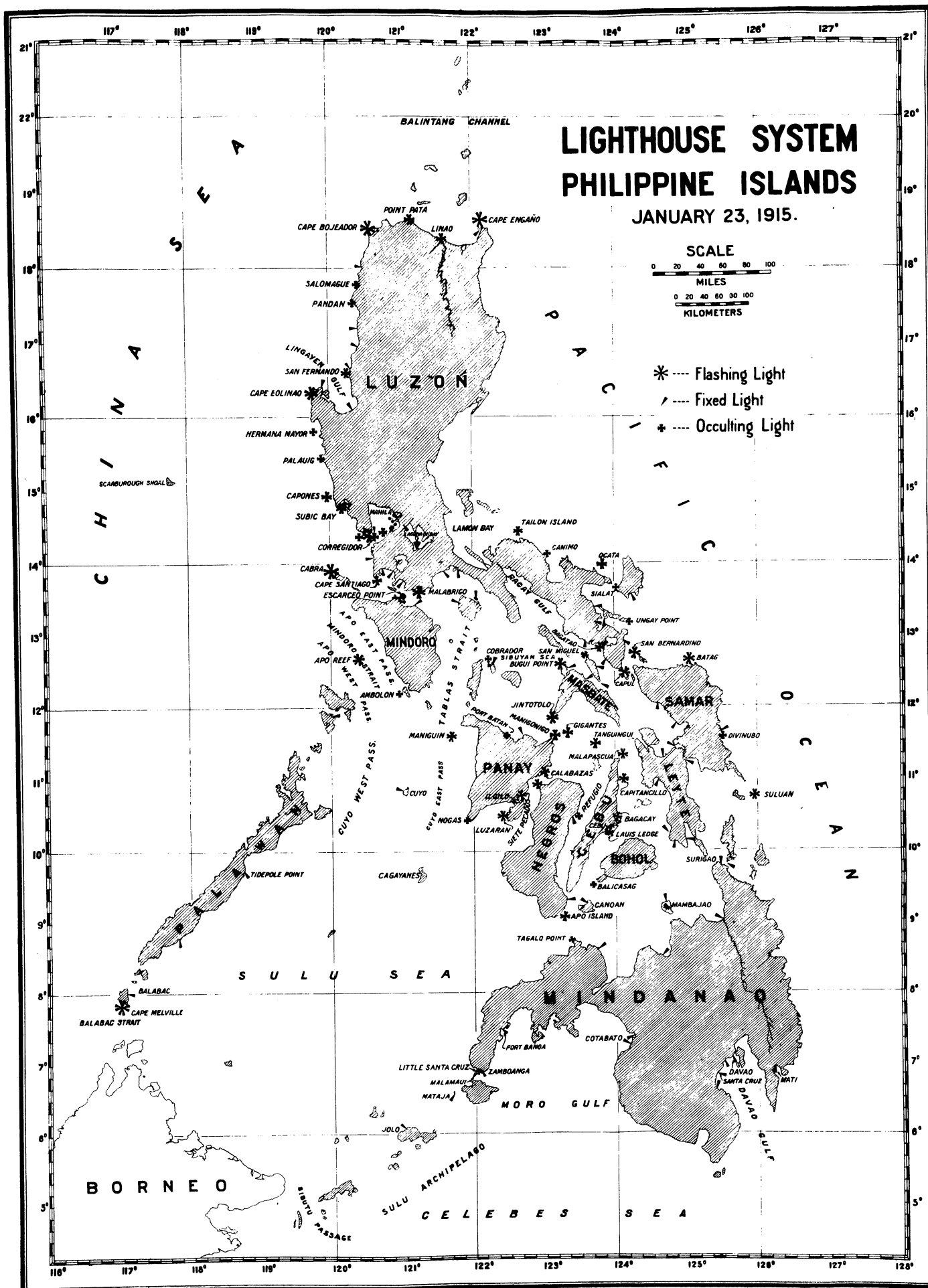
Steamships while laying at anchor are not earning money for their owners, whether waiting for a tide to enable them to cross a bar, waiting for the loading or discharge of cargo by slow and cumbersome methods, or for daylight to enable them to navigate dangerous unlighted channels.

Navigation by night very materially increases the efficiency of vessels, and coincidentally reduces the cost of transportation, but with narrow tortuous channels separating the various islands, fringed in many places by coral reefs thousands of feet or even miles in width, together with the numerous isolated reefs and shoals rising almost perpendicularly from depths of 20 or 100 fathoms, to within a few feet of the surface, lying either directly across, or immediately adjacent to, the most direct routes between capes and headlands rounded by vessels on their courses, with perhaps not more than 5 feet of water over their crests at low tide, and yet unless outlined by the breakers of a rough sea, may be approached within a few hundred feet in broad daylight before any visible evidence of their existence is discovered, navigation by night is obviously impracticable without the assistance of lights. The loss and risk of life and property, together with excessive insurance rates, would



It is accordingly estimated that while all our exports are loaded at least once, 90 per cent thereof are handled three times, while in the reverse order all our imports are discharged at least once, and 50 per cent are again loaded and discharged before reaching

be prohibitive, and yet, upon the arrival of the first American Philippine Commission, there was not a single adequately improved port and only 29 lighthouses and minor lights in serviceable condition in the entire Archipelago.



To one who has had no occasion to make a minute or detailed study of a map of the Philippine Islands, the full significance of this last statement may not be at once realized.

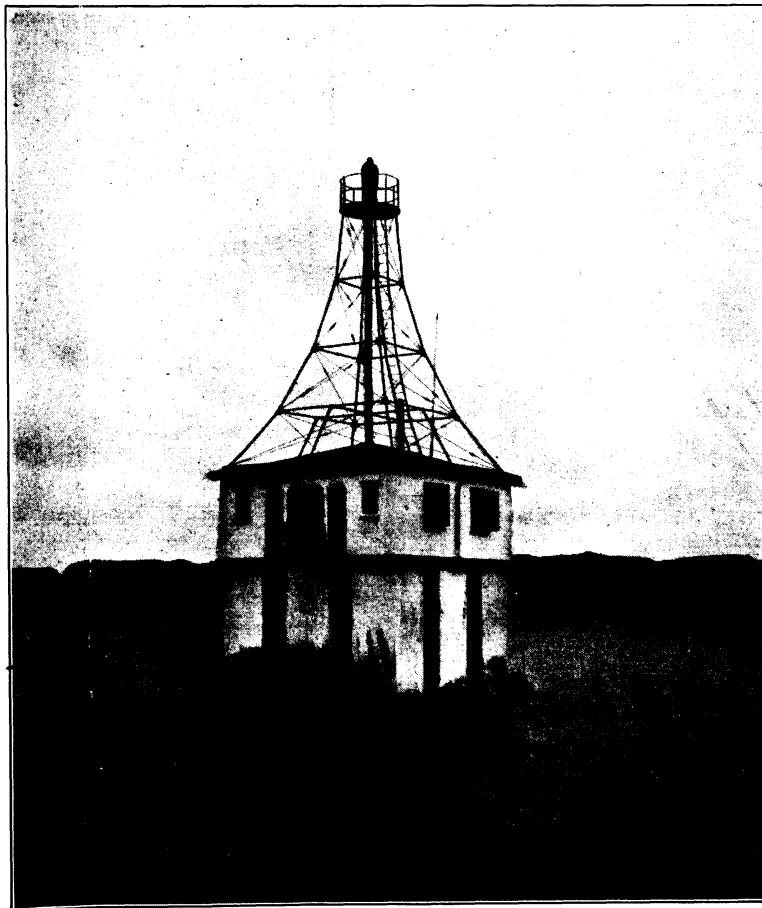
A map of the Islands when viewed as a part of a map of the world, or a statement to the effect that the combined area thereof is approximately 115,000 square miles (about 71 per cent of that of Japan, including Formosa; 95 per cent of that of the British Isles; a little more than that of Arizona, though less than that of New Mexico) does not convey to the average American the idea of vastness.

A better idea of the situation may perhaps be conveyed by the statement that the Archipelago measures more than 1,000 nautical miles from north to south, and more than 600 from east to west; that the total coast line is approximately equal to that of the combined Atlantic, Gulf, and Pacific coasts of the United States, exclusive of Alaska, and that there are more than 5,000 nautical miles of coasting routes and tortuous channels regularly navigated by vessels trading among some 300 separate ports.

From the records kept at the various light stations of vessels passing by night, it is conservatively estimated that an average of not less than 18,000 nights sailing is annually gained by the 11,600 vessels (coastwise and foreign) entering our six open ports, and the value of which (time) based upon the average tonnage of 278 derived from the customs records, is conservatively estimated at ₱750,000 per annum to the ship owners.

This, when added to the saving possible by port improvements, increases the total to ₱8,695,000.

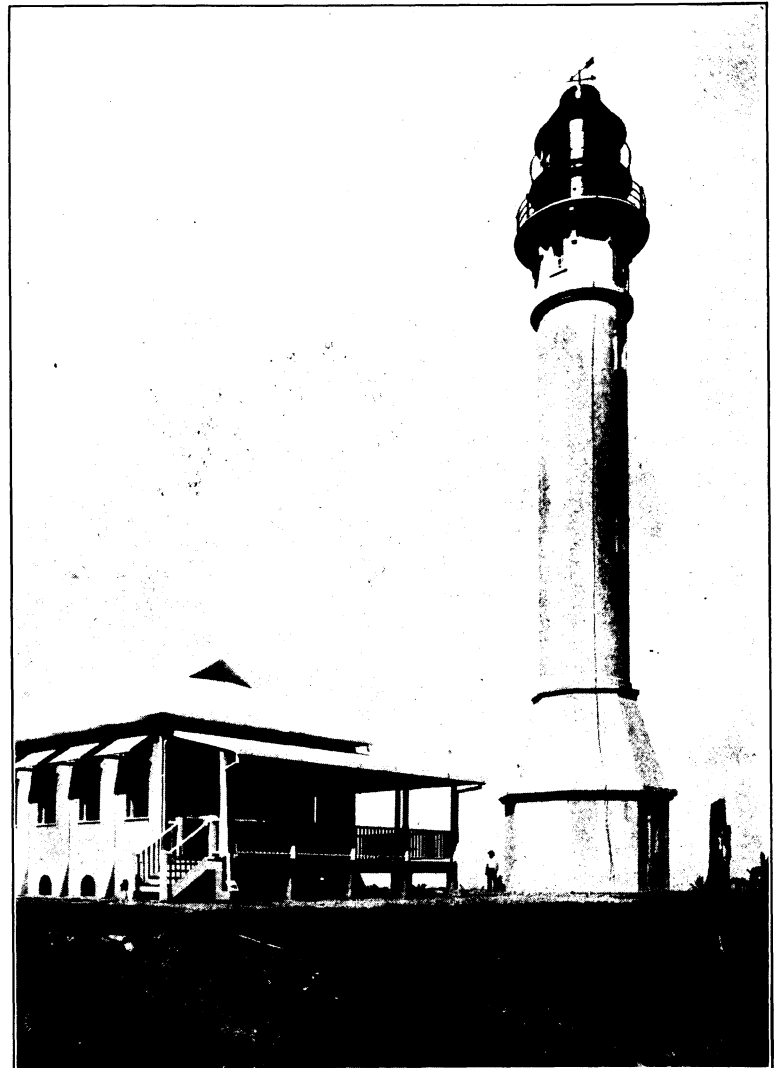
0.1 per cent for the retirement of all bonds at the end of one hundred years, we have a saving, based upon our *present* commerce sufficient to justify a bond issue and outlay of ₱114,400,000 for port works and lighthouses.



Louis Ledge.

Built on coral reef submerged 10 feet. Sixth order occulting light, 54 feet above high water; visible 13 miles.

Deducting from this an amount equivalent to 4 per cent on the investment for interest, 1.5 per cent for maintenance and repairs (which would be ample for the types of construction carried out to date), 2 per cent for reconstruction (upon the assumption that the average life of structures would not exceed fifty years), and



Cape Bolinao.

Third order flashing light on reinforced-concrete tower 101 feet from base to focal plane. Total height, 301 feet; visible 24 miles.

Our investment to date, including expenditures by the Spanish Government, has been perhaps ₱20,000,000.

PORT OF MANILA.

The "port" of Manila was originally an open roadstead, with nothing worthy of designation as a harbor.

Located upon the easterly shore of Manila Bay, it was somewhat better protected than had it been fully exposed to the China Sea, but with Corregidor Island 27 nautical miles to the southwest, the "fetch" is sufficient to permit the generation of waves of such size, particularly during the southwest monsoon, that prior to the construction of the outer harbor, with its protecting breakwaters, the lightering of cargo to and from vessels in the bay was often suspended for days at a time, pending the subsidence of the sea to a point that would permit resumption, while upon the approach of a typhoon all vessels were forced to flee to Mariveles, 28 miles away for shelter.

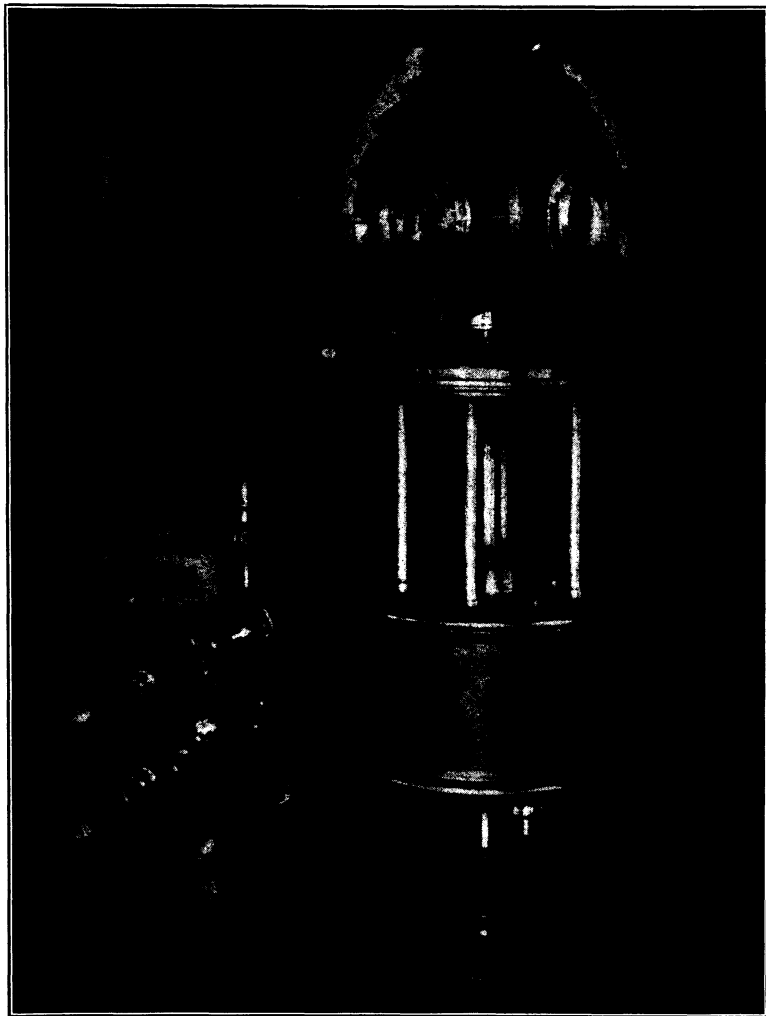
The city is practically bisected by the Pasig River, the mouth of which was originally at Fort Santiago, and closed to navigation by vessels larger than bancas or cascos by a bar submerged at low tide to a depth easily measured in inches.

From the Spanish records we learn that the construction of timber jetties at the mouth of the river, for the purpose of confining the

waters to a narrower channel across the bar, were begun in 1755; that as the bar receded under the erosive action of the current, the jetties were extended from time to time, and that in 1833 a dredge was purchased and a narrow entrance channel was dredged to a depth of 2 fathoms at low water.

The "port" then consisted of the lower reach of the Pasig River from the Bridge of Spain to the bay, less than 1 mile in length, less than 500 feet in width, and with a depth of 12 feet obtained only by extensive dredging.

The next improvement undertaken was the construction of "muelles," or quays, along the banks of the river, consisting of light masonry retaining walls, built either upon the natural river banks, or with very shallow excavations for foundations, and backfilling and paving a roadway in the rear thereof, which enabled the small vessels



Sixth order dioptric flashing apparatus, with mercury float and revolving mechanism.

then entering the port to moor near enough to permit the loading and discharge of cargo by hand over long gangways spanning the space between ship and wall.

The first suggestion of the present outer harbor, which is an entirely artificial one, seems to have been made by military engineers, who proposed to construct a breakwater in the bay upon which a fort might be built for the protection of the city in time of war, to serve as a refuge for naval vessels, and *incidentally* perhaps benefit the commerce of the port.

In 1867 a bureau of public works was established to which was assigned, among other duties, that of studying the improvement of the port of Manila.

A preliminary report with plans was submitted nine years later, in 1876, by Sr. Don Eduardo Lopez Navarro, which was somewhat modified and approved by proper authority in Spain in 1879, and work was finally begun in 1880.

Limited space will not permit a repetition of a detailed history of the project here, suffice it to say that upon the arrival of the American forces in 1898 after three hundred seventy-five years of Spanish rule, thirty-one years after the study of the project had been undertaken, and after at least sixteen years of construction (the work was dis-

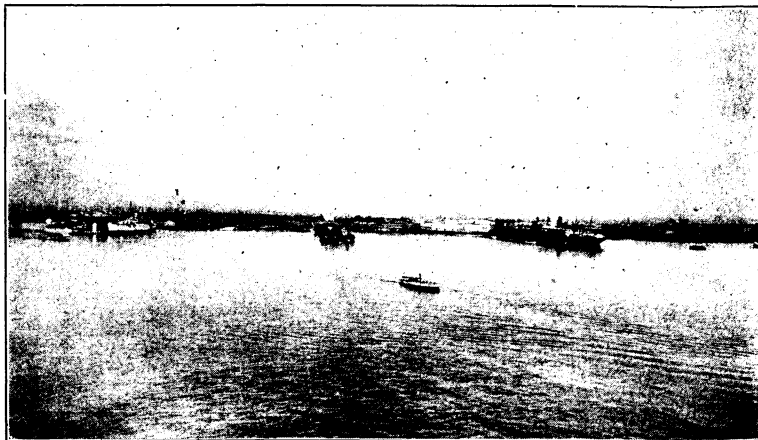


Automatic flashing acetylene beacon, entrance to harbor, Manila.

continued some time after the outbreak of the insurrection of 1896) the project had not yet been sufficiently developed to afford protection for vessels or to materially facilitate the handling of cargo.

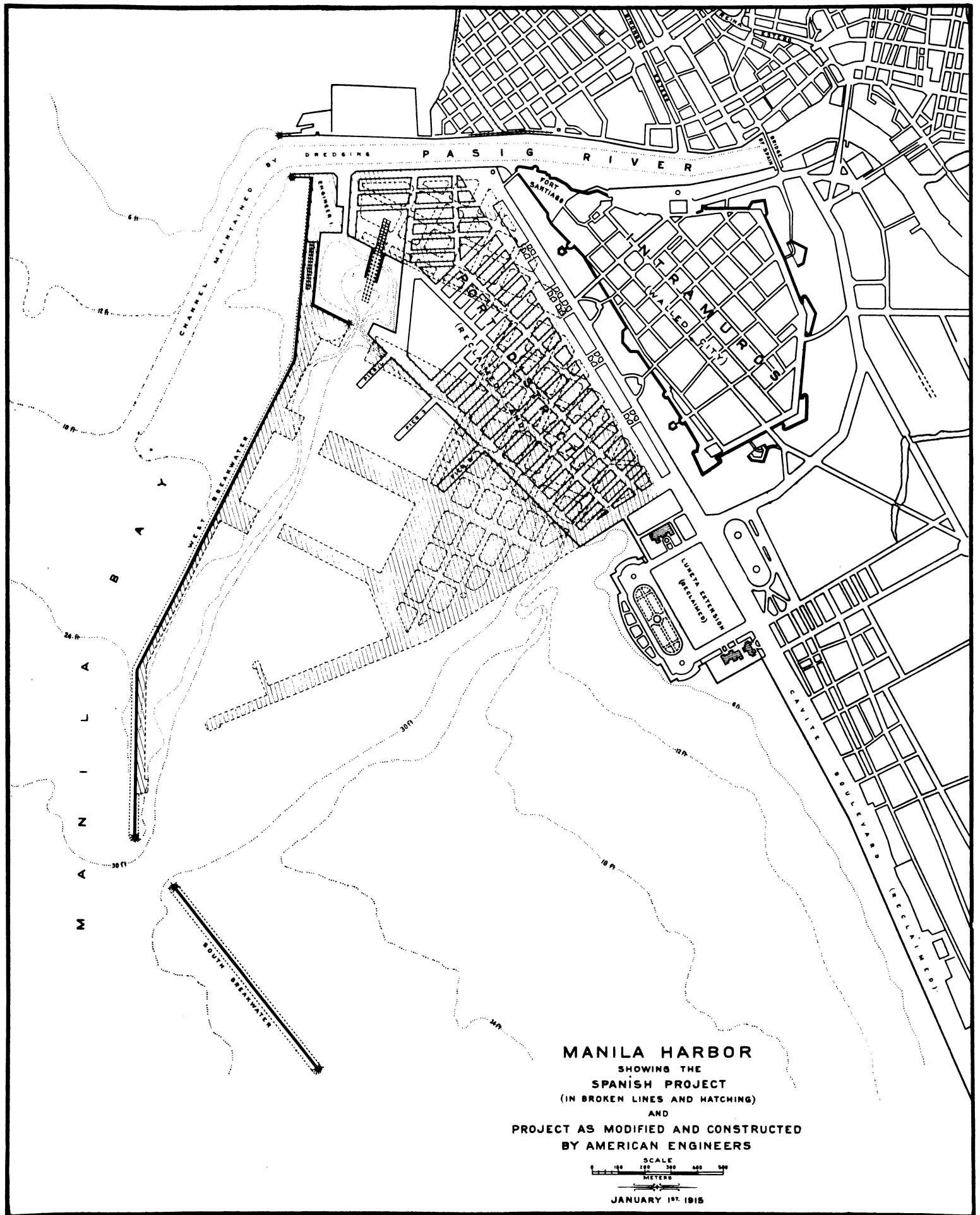
Perhaps 90 per cent of all cargo handled was loaded or discharged by the slow and expensive means of lighters, operating between warehouses along the banks of the river and vessels anchored in the bay a mile from shore, while the remaining 10 per cent was carried upon the backs of men over the long gangways above mentioned.

This deplorable state of affairs was at once recognized by the first American Philippine Commission, who in their report for the year 1900, called attention thereto, and who by one of their earliest official acts after the establishment of civil government (No. 22, enacted October 15, 1900) appropriated \$1,000,000 United States currency for the improvement of the port of Manila.



Piers of Manila Harbor. Steamship Manchuria on right.

The work was at first placed under the charge of the chief engineer of the Philippine Division, U. S. Army, who found that the Spanish plans, in accordance with which a portion of the work had already been done, were based upon the system followed at a number of European ports, but poorly adapted to the conditions then existing at Manila, or to a port whose commerce was ever likely to increase.



A series of rectangular basins of different depths, to be inclosed within masonry retaining walls and ultimately surrounded by land reclaimed from the bay with material to be dredged from the basins, were provided for.

The walls could not be built until after the completion of a breakwater for their protection from the heavy seas generated by passing typhoons. No dredging could be done until the walls for retaining the material had been completed, and it was accordingly clear that if carried out in accordance with such plans, several years more would elapse before any benefits would begin to accrue from the partly completed project.

There were other defects in the plans too, such as the fact that when once completed, the basins could not be deepened to keep pace with the constantly increasing draft of vessels without undermining the walls, while the entrance was so located that during stormy weather a vessel would have been compelled to turn broadside to the heavy seas generated by the southwest monsoon while entering.

It was apparently the assumption of the Spanish engineers—in fact, it was so stated by Señor Navarro—that vessels would not attempt to enter the harbor during a storm, but would seek shelter at Mariveles instead; but the construction of a harbor along such lines does not conform with the principles of practice followed by American engineers, and radical changes were accordingly made in the plans, care being taken to utilize as far as possible all work already placed by the Spanish engineers.

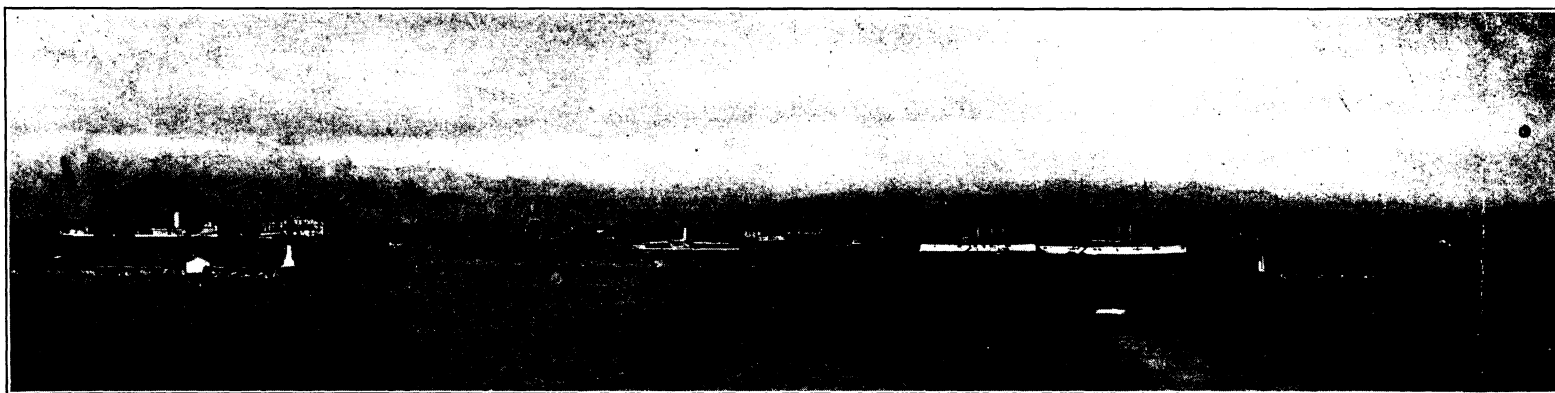
The west breakwater, started and approximately one-half built by

Government for public use, are, respectively, 21.3 by 182.9 and 33.5 by 198.1 meters (70 by 600 and 110 by 650 feet), with reinforced-concrete deck slabs upon structural steel floor systems, supported by steel cylinders filled with reinforced-concrete, resting upon timber pile foundations, the whole surmounted by steel frame and corrugated galvanized-iron sheds, respectively, 18.3 by 167.6 and 30.5 by 182.9 meters (60 by 550 and 100 by 600 feet) inclosing 8,640 square meters (93,000 square feet) of surface for the temporary protection of cargo while loading, discharging, undergoing customs inspection, etc.; equipped with, respectively, 6 and 10 overhead traveling electric hoists, each of 1-ton capacity, for loading and discharging cargo on and off of trucks, carts, etc., and cost complete, respectively, ₱500,000 and ₱790,000.

The "inner basin" of 9.3 hectares (23 acres) has been dredged to and maintained at a depth of 18 feet at low water.

The channel across the bar at the mouth of the Pasig River, together with the lower reach of the river itself up to the Bridge of Spain (6,000 feet above the present mouth), have been dredged to and maintained at a depth of 18 feet at mean low water over a width of 91.4 meters (300 feet) by the original removal of some 600,000 cubic meters, and the additional average annual removal of 400,000 cubic meters of mud and silt, while an additional 600 lineal meters of concrete river wall has been constructed along the south bank below the Bridge of Spain with a short section on the north bank at the bridge approach.

The shoals of the upper Pasig River, from the Bridge of Spain



Entrance to Manila Harbor.

the Spaniards, was completed with a total length of 2,652 meters (8,700 feet) by the addition of 266,000 metric tons of stone, 7,827 cubic meters of rubble masonry, and 4,110 cubic meters of concrete, at a cost of ₱1,661,000.

The south breakwater, not provided for in the Spanish plans, 884 meters (2,900 feet) in length and containing 520,000 metric tons of stone, was built at a cost of ₱1,760,000 to date, including small quantities of additional stone recently placed to compensate for settlement at one end.

Sheet pile and riprap bulkhead walls totaling 2,825 meters (9,266 feet) in length were built at a cost of ₱1,165,000, and 6,074,470 cubic meters (7,945,062 cubic yards) of mud, sand, and silt dredged from an area of 172 hectares (425 acres) under the protection of the breakwaters, and to an average depth of 30 feet at mean low water, at a cost of ₱3,013,200.75 was deposited in the rear thereof, reclaiming 115 hectares (286 acres) of land, of which 87 hectares (215 acres) has been set aside as a warehouse district, 26 hectares (65 acres) as an extension of the park system of the city in accordance with the approved plans for the development thereof, and 2.4 hectares (6 acres) (Engineer Island) is now occupied by Government machine shops and marine railways.

Three miles of paved streets and 2 miles of storm water drains and sewers have been constructed in the port (or warehouse) district.

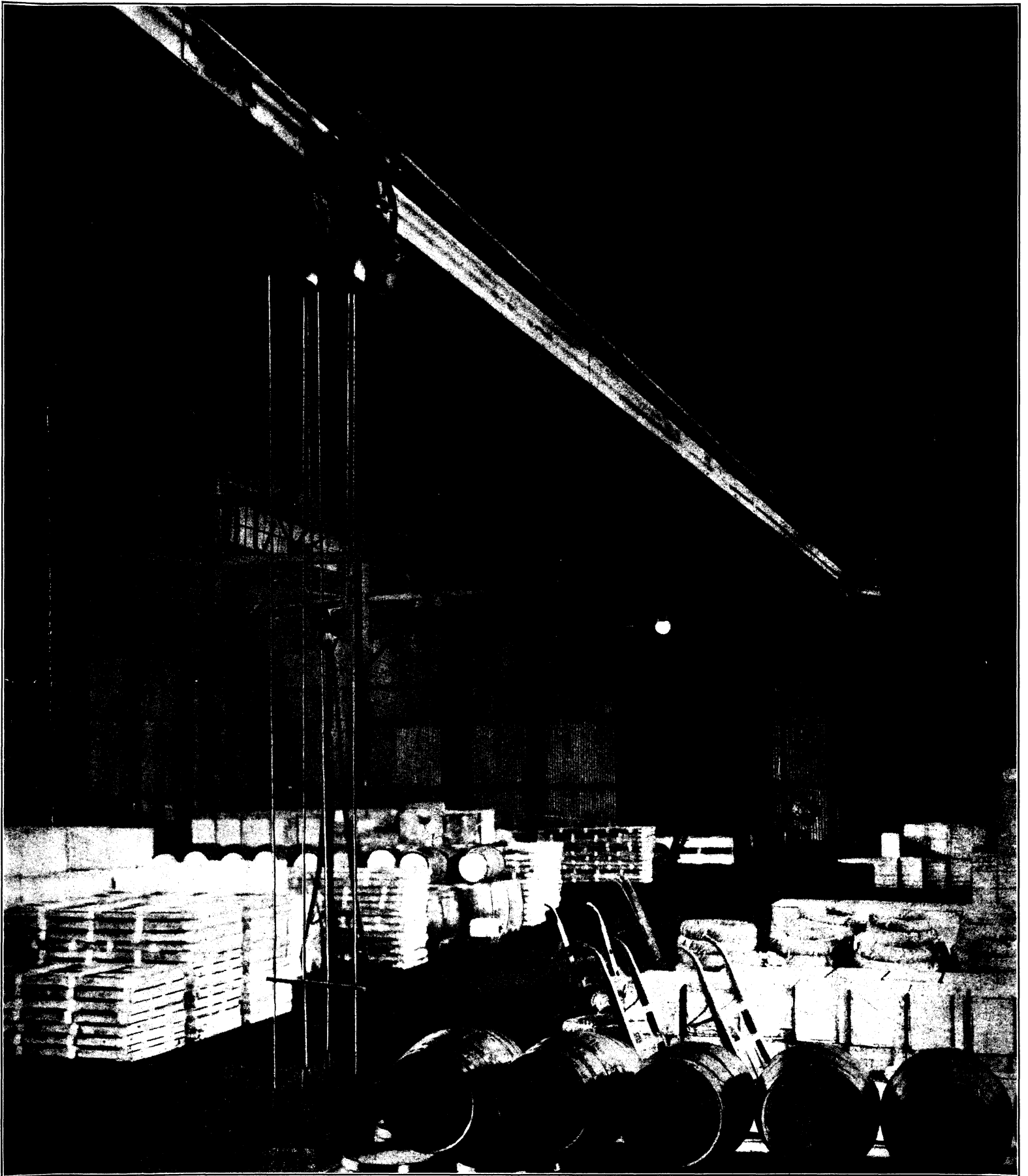
Three piers have been built, one by the Federal Government for the exclusive use of U. S. Army transports, originally built of timber and now in course of reconstruction in reinforced concrete, is 18.3 by 167.6 meters (60 by 550 feet), the other two built by the Insular

to the Laguna de Bay, some of them originally covered to a depth of less than 1 foot at low water, have been removed to, and maintained at, a minimum depth of 6 feet at low water by dredging, while some 7 miles of esteros extending into all parts of the city have been dredged to depths navigable at low tide by loaded cascos and lighters.

The original dredging in the outer harbor was done by contract, but all work in the Pasig River and esteros, and all maintenance dredging elsewhere, has been done by our own dredges of which we now have seven, including one small quarter-yard clam shell, and one half-yard dipper dredge for estero work, one 12-inch hydraulic, and one 1-yard dipper dredge for work in the upper Pasig River, two ladder bucket dredges each with a capacity of 250 cubic meters per hour, inherited from the Spanish Government, and one seagoing Fruhling system suction dredge equipped with two 16-inch pumps capable of raising 1,000 cubic meters of mud per hour from a depth of 42 feet.

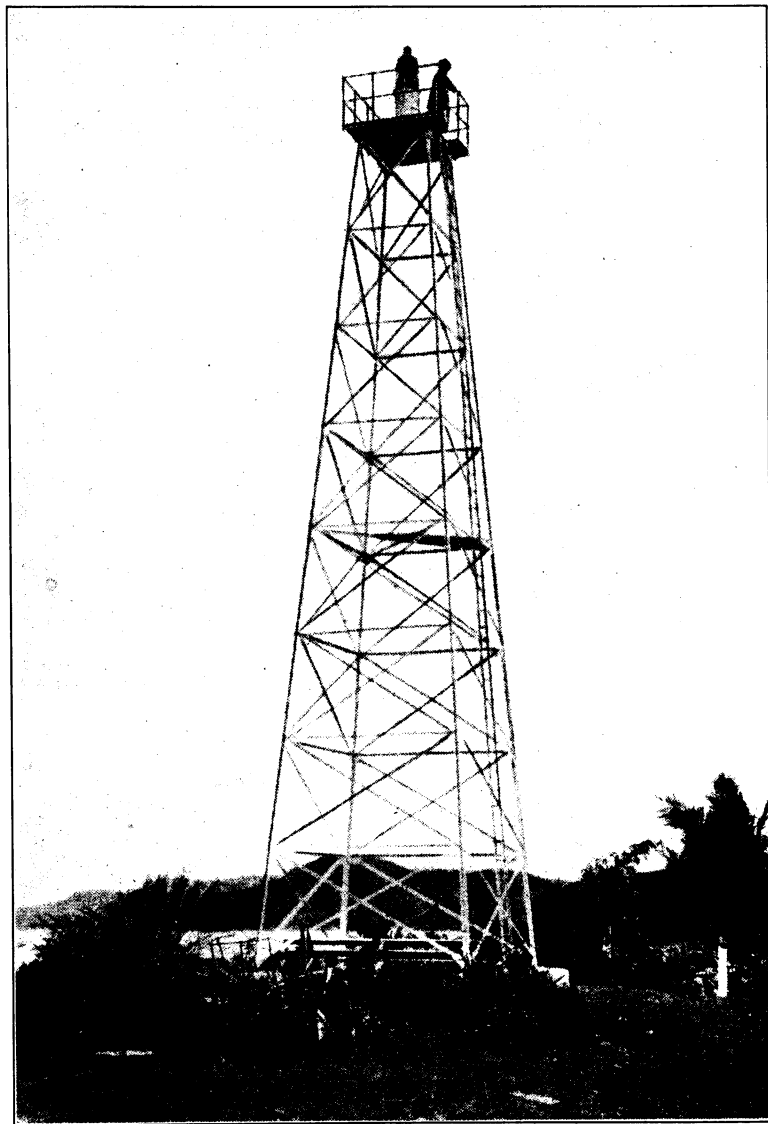
The improvement of the port is yet far from complete, but for the funds expended to date (approximately ₱12,000,000) it would have been difficult to have accomplished more actual improvement of conditions as we found them.

Sufficient wharfage to handle all the commerce of the port has not yet been provided but such as we have is available for the largest vessels in the Pacific trade, the depth of water alongside, now 30 feet at low water, may be increased to 36 feet whenever desired simply by additional dredging, and additional piers may be added at any time without changing the plans, and without interfering in any manner with the full use of the completed works, while



even in its present uncompleted state we have more than 800 acres of protected anchorage that may be reached at any time that weather conditions will permit navigation on Manila Bay by any vessel in the interisland or Pacific trade, and where vessels unable to secure a berth at the piers may safely load or discharge cargo by lighter under any ordinary weather conditions.

The further extension or completion of the project has been delayed by the lack of funds. To finance such improvements, the Spanish Government had in 1881 imposed special duties on all imports and exports, together with a tonnage tax on all vessels entering the port, the former consisting originally of 1 per cent on exports and 2 per cent on imports, the latter of 10 centavos per ton on all



Sixth order port light, Legaspi. Standard 50-foot steel tower.

coastwise and 20 centavos per ton on all foreign vessels; but while such a system apparently places the tax upon those who benefit directly from the improvements, and might perhaps be successfully employed if universally adopted, it constituted a serious handicap to the port of Manila.

It resulted in vessels, particularly the larger ones, shunning the port, and it was useless to attempt to induce the owners of vessels passing even within a few miles of the entrance to Manila Bay to make it a port of call without a guaranty of sufficient revenue to insure profitable results.

Such taxes were accordingly abolished by the new Government and vessels of any size may now enter and clear upon the payment of a nominal fee of ₱4 (\$2 United States currency), and port improve-

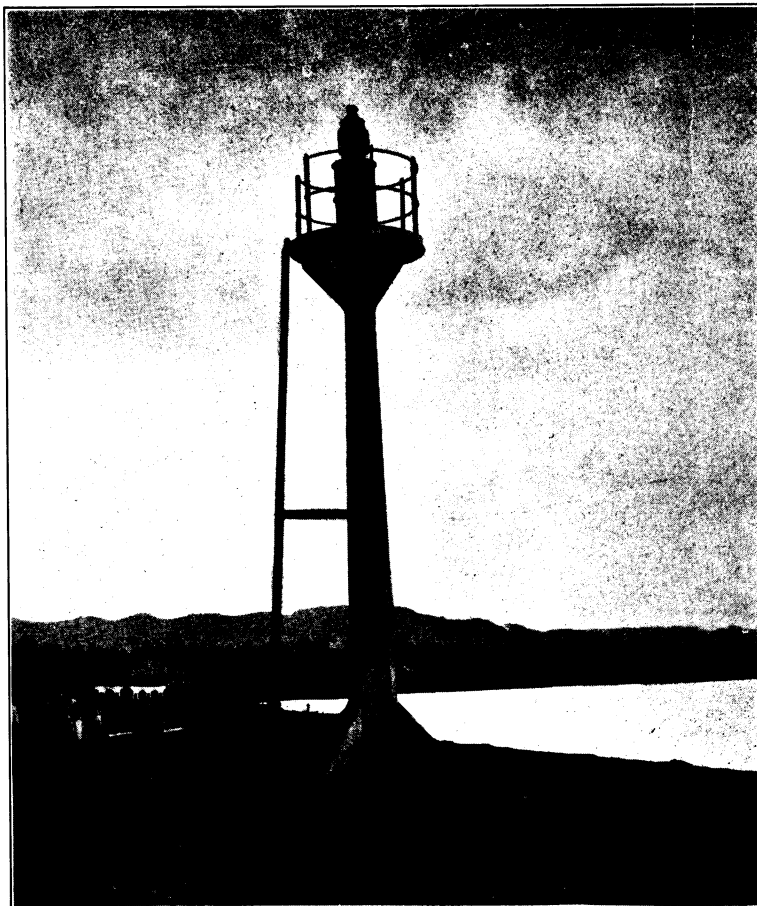
ments and lighthouse construction have since been financed either from the proceeds from the sale of public improvement bonds, or by appropriations from revenue funds, which in view of the comparatively



Subic Bay light and lighthouse tender.

Sixth order flashing apparatus mounted in cylindrical steel tower 30 feet from base to focal plane. Total elevation above sea level, 207 feet. Visible 20 miles.

few bonds issued, the constant expansion of the Government organization in other fields requiring increasing shares of the revenues, and the necessity for improving other ports, has rendered it neces-



Ormoc beacon.

Standard reinforced-concrete beacon for minor lights. (A modified form provides a chamber in the base for acetylene accumulators.)

sary to practically "mark time" in the development of Manila Harbor during the past three or four years, while other ports were being improved.

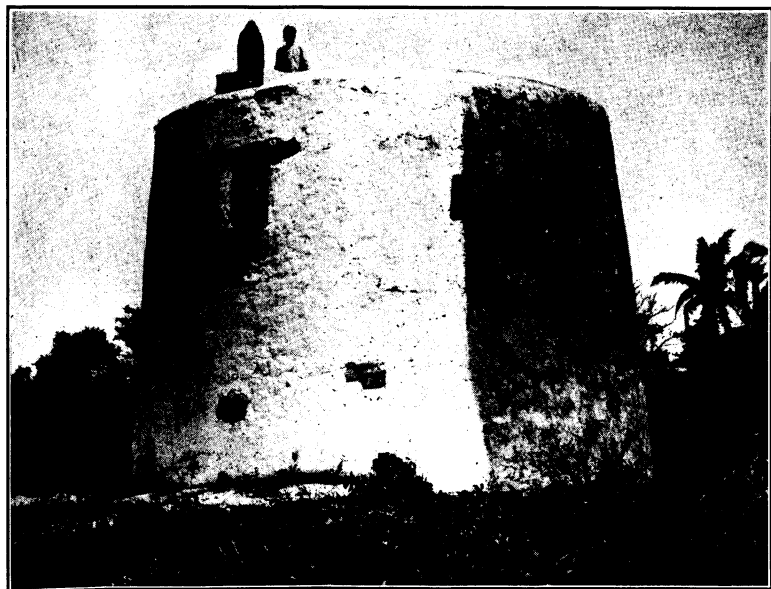
CEBU.

At Cebu, the second port of the Archipelago, where two small timber piers with T heads approximately 15 meters in length, available for vessels of 15-foot draft, had been built by private parties, and 90 per cent of the commerce of the port was being handled by lighter, 666.9 meters (2,188 lineal feet) of gravity section concrete



Standard dwelling for keepers of minor lights.

sea wall and 250 meters (820 lineal feet) of plain and reinforced-concrete wharf have been built, of which the latter is available at low tide for vessels of 30-foot draft, 316 meters (1,037 lineal feet) of the wall, for vessels of 23-foot draft, and the balance of 350.8 meters (1,151 feet) for vessels of 18-foot draft, 5.26 hectares (13 acres) of valuable land was reclaimed in the rear of the wall with the 160,000 cubic meters of material dredged from 5.7 hectares (14 acres) of berthing space in front, at a total cost to date of approximately ₱1,500,000.



Currimao.

Lens lantern mounted upon an old watchtower. An ancient lookout station to observe the approach of Moro pirates.

With these improvements, with due consideration for relative volumes of commerce, Cebu is to-day the best-equipped port in the Islands, and is the only one where coal and similar cargo may be discharged directly from the ship to railway cars for inland transportation.

That such results were possible within the cost named was due to the more favorable conditions to be dealt with.

The harbor consists of a portion of the Strait separating the

Islands of Cebu and Mactan, approximately 600 meters in width, through which a channel 10 to 15 fathoms in depth is maintained by the tidal current.

Located very near the geographical center of the group known as the Visayan Islands, it is rarely visited by disastrous typhoons, and is well protected except during the months of August and September, when the seas entering from the southwest sometimes prevent the use of the westerly section of the sea wall for a few days at a time.

Warehouses were already located immediately adjacent to the shores and landing places, the lands reclaimed as a port of the project formed a welcomed extension of the warehouse district and were immediately occupied as such, with the result that a large part of the hemp, which constitutes the chief article of commerce, is discharged within 30 meters of the warehouse doors, where it is dried, sorted, baled, and stored and finally loaded upon large foreign freighters moored within 100 meters of the doors, for export.

ILOILO.

At Iloilo, the third port of the Archipelago, the harbor consists of three short reaches of the Iloilo River (which is really only a tidal estuary connected with the sea at both ends) together with a portion of the strait between the Islands of Panay and Guimaras, into which the river empties, and which serves as an anchorage for the larger vessels unable to enter the river.

In 1904 the depth of water in the mouth of the river was less than 11 feet at low tide and the channel very narrow and tortuous.

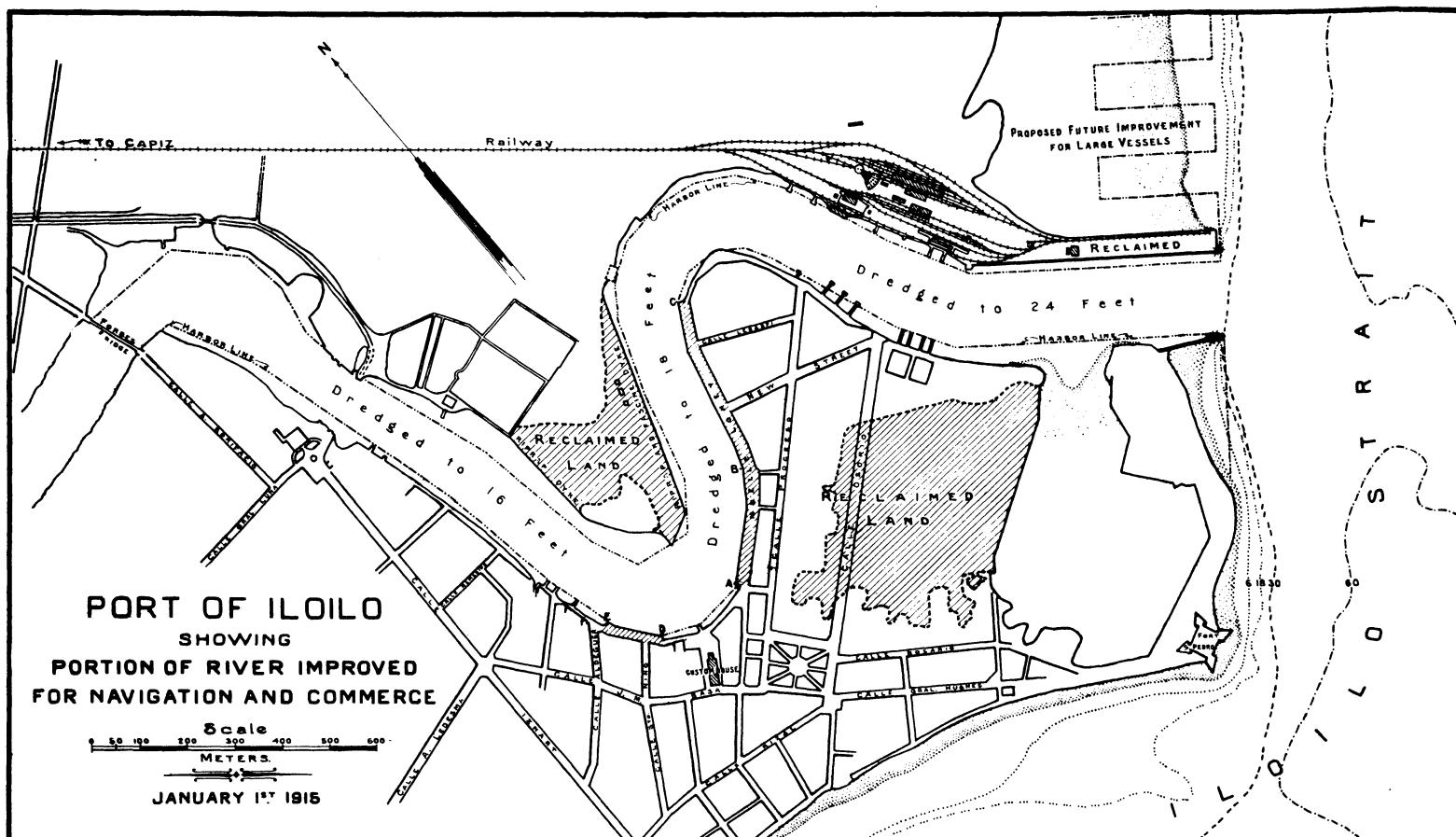
The lower reach was bordered on either side by swampy lands, almost entirely unoccupied, and such small vessels as were able to enter the river, proceeded to the second reach, where a "muelle" or quay some 840 meters in length, consisting of a filled-in roadway retained by light masonry walls some 2 meters in height founded upon the natural surface of the river bank at about the elevation of mean low water and protected from underscour by riprap placed upon the sloping natural bottom below, had been built, and where cargo could be loaded and discharged by hand over long gangways as at Manila.

The work had evidently been carried out by the owners of the various sections of riparian property without regard to any definite plan for the general improvement of the port. The most favorable ground for cheap construction had evidently controlled the location of the various sections, no two of which were of the same design, with the consequence that the muelle varied in width from 8 meters to 17 meters, with the narrowest portion at the end nearest the commercial center of the city where traffic was heaviest; and it was no uncommon occurrence for traffic to be brought a standstill by cart wheels locking together on the narrow muelle while attempting to pass.

The first improvement undertaken, was the construction of two riprap jetties, respectively, 122 and 272 meters (400 and 900 feet) in length at the river mouth, the construction of 1,525 meters (5,000 feet) of stone and fascine dykes along the swampy banks to serve as retaining walls, and the dredging of a channel 15 feet in depth at low water and 92 to 122 meters (300 to 400 feet) in width up to the upper end of the second reach, a distance of 2,286 meters (7,500 feet) to where the custom house was located.

The work was done by contract at a cost of approximately ₱525,000, and incidentally some 18 hectares (40 acres) of swampy lands were made available for use by the deposit thereon of the 363,968 cubic meters (476,049 cubic yards) of sand and mud dredged from the channel.

A material improvement over the previously existing conditions was thus effected, but landing facilities were still entirely inadequate, and, furthermore, the old walls above mentioned with their defective foundations were gradually failing. Sections of it had already settled to such extent that high tides overflowed the "muelle," other sections were overturning from the pressure of the backfill, while practically all of it was disintegrating under the action of the salt water on the faulty materials employed in their construction, and it was only a question of time until the water front would have been reduced to its original unimproved condition.



Funds were accordingly appropriated (1907) for the construction of a new wall to replace the old, and work was begun under the supervision of the writer during the following year.

As will be noted from the map herewith, vessels are compelled to pass a bend, or curve, of approximately 175 meters radius, over an arc of 145° through a channel 125 meters in width before reaching the section of river under discussion, a curve that would be difficult of passage by vessels exceeding 300 feet in length, at least without the assistance of snubbing lines or tugs, and it was accordingly decided to provide only for vessels up to 18-foot draft in this section or reach, with a "muelle," or quay, 24.4 meters (80 feet) in width.

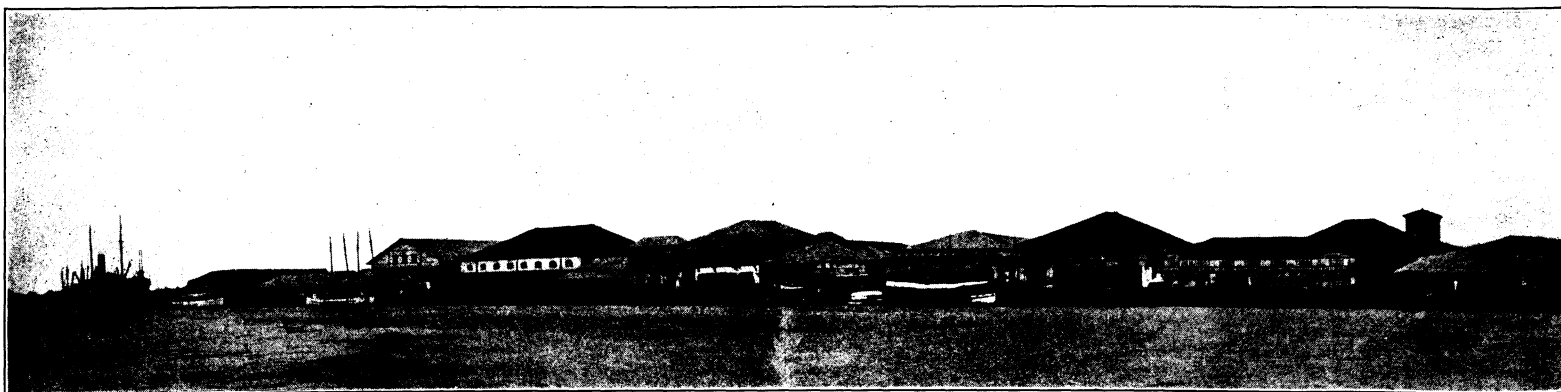
As above mentioned, the old muelle varied in width from 8 to 17 meters, and it was found that the banks were sufficiently steep in front of the narrow section, due to its position on the convex bank of the second curve, to permit the construction of a concrete retaining wall of gravity section in front of the old, extending to a depth of 20 feet below low water, with very little excavation and without undermining the old wall.

The work was accordingly so started, beginning at the point marked

"A" (on plan) and working downstream, building in section 13.7 meters (45 feet) in length, of which the lower 3 meters (10 feet) was placed by means of bottom dumping buckets, and after allowing this ample time to set and harden, the forms were pumped out and the remainder cast in the open air; the whole resting upon a foundation composed of timber piles averaging approximately 12 meters (40 feet) in length driven by a floating driver to a cut off grade of 18 feet below low water, and a safe bearing power of 20 tons per pile, in transverse rows of 4 piles each, alternately vertical (rows) and battered 1 horizontal to 3 vertical, the better to resist the thrust of the backfill.

Upon completion of 241.5 lineal meters (792 feet) of wall of this type, the new work, which was following a line parallel to the building line, had reached a point (B on plan) where the width of the old "muelle" was such that a continuation in kind would have necessitated the removal of the old wall, together with a considerable increase in excavation and incidentally in cost.

The plans were accordingly changed and the project extended an additional 396 meters (1,300 feet) to point C (on plan), in reinforced concrete.



Portion of Iloilo water front, showing downstream end of gravity section retaining wall and reinforced-concrete wharf.

Under the new plan, foundation piles were driven in groups of from 4 to 7 (according to the bearing power developed in driving) at intervals of 10 feet from center to center of groups, immediately in front of the old wall. Upon each of these groups of piles a concrete pedestal, extending to the mud line below the lowest tide, was cast in such a manner as to support the old wall and at the same time serve as a support for the shore end of a heavy reinforced-concrete beam, the outer end of which is supported by a cylindrical reinforced-concrete column 61 centimeters (2 feet) in diameter, cast on shore and set in place in a bed of clean gravel confined by a sheet-metal cylinder surrounding the heads of a group of timber piles previously driven to a grade of 5.5 meters (18 feet) below mean low water. The mass of gravel surrounding pile heads and column was then cemented into a solid block of concrete with neat cement grout poured through 1-inch pipes placed at various points around the column and one down through its center. When the grout had set hard, the water was pumped out and the hollow column filled with concrete.

The beams were cast monolithically with a section of slab from center to center of slab span, and the whole finished with a macadamized road surface rolled down with a 10 ton road roller.

The total cost of the gravity section wall requiring 12,924 lineal meters of foundation piling, 6,330 cubic meters of concrete, 785 cubic meters of riprap and 20,752 cubic meters of backfill, with cast-iron moorings etc., was approximately ₱194,000, while the cost of the reinforced-concrete wharf was approximately ₱206,000, or a total of ₱400,000 for 638 lineal meters of quay for vessels of 18-foot draft at low water.

While this work was under way by administration, a second contract for dredging was let, and under the provisions of which the lower reach of the river was deepened to 24 feet at mean lower low water over a width of 52.5 meters (500 feet), the second or middle reach was deepened to 18 feet over a width of 19 meters (300 feet), and the third or upper reach to 16 feet over a width of 61 meters (200 feet) by the removal of 906,878 cubic meters of sand and mud which was used for the reclamation of 210,000 square meters of public (tidal) lands, and for filling in and improving an additional 206,000 square meters mostly of private ownership. This work was completed December 7, 1910 at a cost of ₱430,840.08.

Upon completion of the dredging above mentioned, which permitted larger vessels to navigate the upper reach of the river, the demand for wharfage along the right bank of that section was suddenly and enormously increased. Funds were appropriated to start the work. The plans for the wharf above mentioned were slightly modified to better conform with the conditions existing in that locality, and a second section 106.7 meters (350 feet) in length was built between the points indicated as D and E (on plan) where the work was discontinued pending the appropriation of additional funds for its extension.

The total expenditures for all improvements at Iloilo to date have been approximately ₱1,500,000.

Besides the improvement of the three principal ports as above outlined, a number of minor ports have been improved, including New Washington, Capiz Province; Bais, Oriental Negros; Paracale (Pulandaga Bay) Ambos Camarines; Pandan, Ilocos Sur; a number of channels were blasted through the coral reefs surrounding the Islands of Batan and Itbayat of the Batanes group; the quarantine station wharf at Mariveles, built of timber in the early days of American occupation, has been recently reconstructed in reinforced concrete and the improvement of the Cagayan River by the removal of rocks and snags, and its control by means of pile hurdles, undertaken. Some of these projects have developed interesting problems, but limited time and space will not permit their discussion in detail at this time.

LIGHTHOUSE CONSTRUCTION.

As above mentioned, upon the American occupation of the Philippine Islands only 29 lights of all classes were in serviceable condition, and of these only a few were in actual operation, many of them having been extinguished during the revolution against Spanish power prior to our arrival. A number of stations had been damaged

or partly destroyed by the insurgents, and the rest had been neglected until they were sadly in need of repairs.

Temporary repairs were made to a number of structures, some additional lamps relighted, and a number of additional minor lights installed by naval officials, so that upon the organization of the Bureau of Coast Guard and transportation under whose charge the construction, operation, and maintenance of lighthouses was placed by Act No. 266 of the Philippine Commission, there were a total of 55 lights in operation, 15 of which were flashing lights of various sizes from first to sixth order, and the balance small lens lanterns, etc., showing fixed lights.

The absence of lights just at a time when the necessity for dispatching vessels to any part of the Archipelago on urgent business might arise at any moment was sorely felt, and a vigorous campaign of construction was at once inaugurated.

As with port improvements, the Spanish Government had started upon an elaborate plan for the illumination of the coast, but comparatively little progress had been made, while here again conditions prevailing along the Spanish coasts, rather than those prevailing in the Philippines, had apparently controlled their plans and radical changes were found necessary if any material improvement were to be effected within a reasonable length of time.

The five large first-order lights, with their luminous ranges of perhaps 50 nautical miles during average weather conditions, installed by the Spanish engineers at Cape Engaño, Cape Bojeador, Capones, Cabra, and Cape Melville, while most excellent lights, are in every case limited to ranges of from 21 to 26 miles by their insufficient elevation, and might have been replaced by third and fourth order apparatus, with a saving of ₱100,000 in the cost of apparatus alone, and ₱5,000 per annum thereafter in cost of operation, with practically no loss of efficiency, as the smaller apparatus would have furnished ample power for the range obtained from such an altitude in the clear atmosphere of the Philippines.

The massive masonry towers and dwellings constructed at these stations, built by prison labor, are of excellent design and workmanship, and while permissible where time and money (or free labor) are plentiful, were not well adapted to conditions where rapid construction and limited funds were controlling factors.

The demand was now for a large number of additional lights at the earliest possible date.

Some additional apparatus, together with steel framework for a number of towers, were found on hand at Manila, additional apparatus was ordered, and construction parties were sent out in all directions with such materials as were immediately available, with instructions to construct stations and install lights as rapidly as possible.

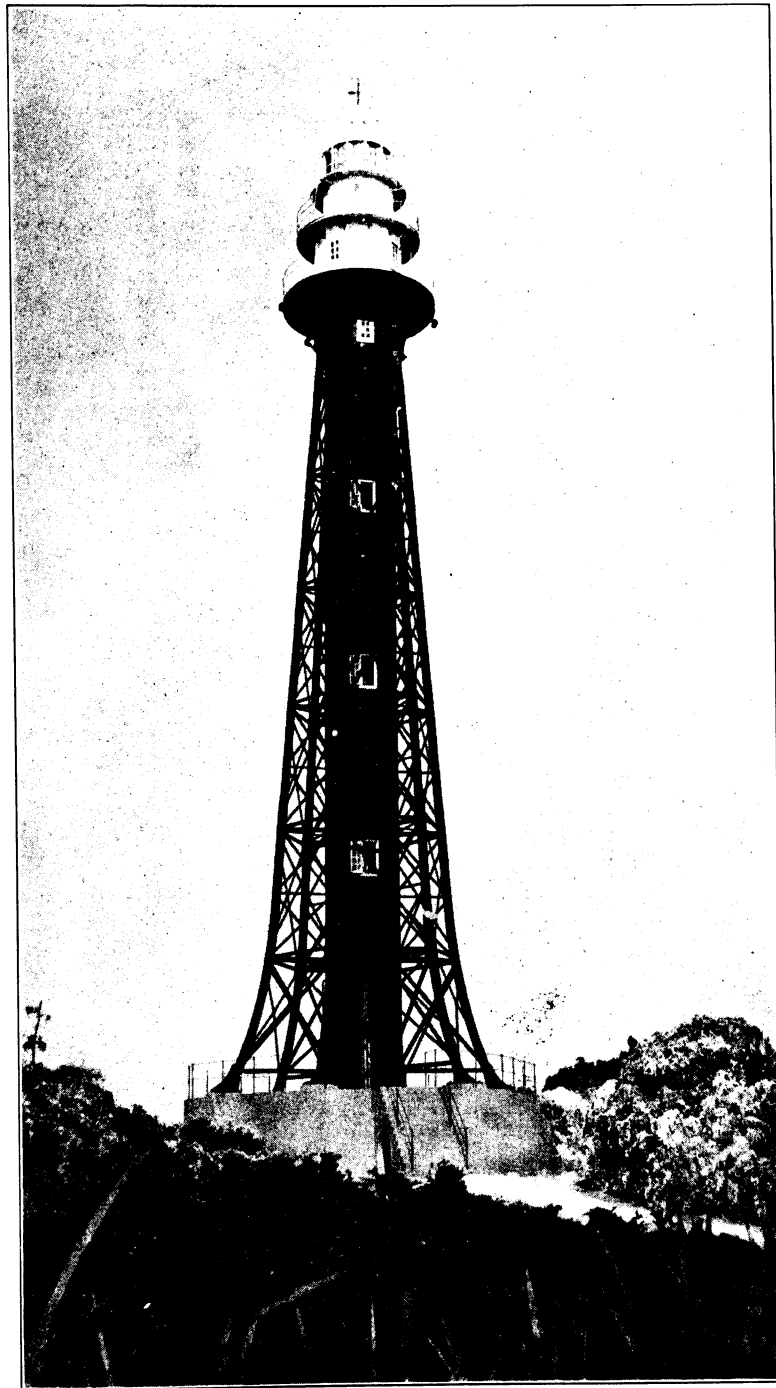
The result was that a number of stations were built partly or entirely of timber, largely of Oregon pine, which were destined to deteriorate rapidly under the ravages of the white ant and natural decay, but within two years the number of lights had been increased from 55 to 81, a net gain of practically 50 per cent, notwithstanding the fact that a few of those previously established were discontinued, and within six years the number had reached 135, while at the present time we have 151 lights of all classes, including 4 first-order flashing (one of the 5 originally installed by the Spanish Government having been replaced by a third-order apparatus on account of a breakdown of the old style revolving mechanism) 1 second-order, 9 third-order, 8 fourth-order, and 12 sixth-order flashing, 20 sixth-order occulting, 9 automatic flashing acetylene, 2 electric, and 85 minor fixed lights, by the aid of which vessels may now safely navigate all the principal routes and channels and enter all the principal ports and harbors.

The system is yet far from complete, however. With the gradual development of the country, the importance of all sailing routes increases and the demand for additional lights now exceeds the capacity of the available funds to supply.

During recent years it has been the policy to use only permanent materials in the construction of new stations, which is naturally more expensive in first cost than the type of construction above referred to; and to rebuild all timber structures in permanent materials as fast as they reach the limit of economical repair, a policy which has

resulted in the installation of fewer lights per annum, but which has rapidly reduced the cost of maintaining the system, and if continued a few years longer will result in placing the entire system upon a permanent basis and a reduction of maintenance expense to a minimum.

For carrying out this work a series of standard structures have been designed, a few of which are illustrated herewith. Minor lights



Apo Reef.

Third order flashing light on structural-steel tower 118 feet from base to focal plane.
Total elevation above sea level, 134 feet; visible 17 miles.

requiring little elevation above the ground are mounted upon reinforced-concrete beacons of the type illustrated, a modified form of which for automatic acetylene flashing lights provides a chamber in the base for acetylene accumulators. Minor lights requiring greater elevation are mounted upon skeleton steel towers of the type illustrated, which are built in heights up to 75 feet, though one of a similar type at Iloilo measures 109 feet.

The more delicate flashing apparatus are mounted chiefly in reinforced-concrete towers, like or similar to, as illustrated, two of which, including the one illustrated and its exact duplicate at Batag Island, measure 101 feet from base to focal plane, equipped, respectively, with third-order catadioptric and third-order dioptric prismatic lenses revolving on mercury floats, which by the refraction and reflection of rays from incandescent oil vapor lamps produce flashes of approximately 100,000 candlepower which are clearly visible under ordinary conditions at the limit of their geographical ranges of 24 and 25 nautical miles, respectively.

The automatic flashing acetylene light has been adopted as most suitable for isolated positions such as the ends of the Manila Breakwaters, San Nicolas Shoal light (marking the edge of a submerged coral reef 5 miles from shore), etc., and a number of oil lamps previously installed in such places are being replaced, and all new installations in such positions are being equipped with apparatus of this type, provided, except in the case of lighted buoys, with sun valves, which automatically shut off the gas at sunrise and turn it on again at nightfall.

Such an apparatus adjusted to a luminous time of one-tenth, i. e., the duration of flashes, and consequently the consumption of gas (except for the insignificant "pilot flame") limited to one-tenth of the total time of operation; with accumulators or tanks of 100 liters capacity charged with acetylene dissolved in acetone under a pressure of 10 atmospheres which is equivalent to 10,000 liters of gas at normal pressure, and controlled by a sun valve and pressure governor, will give regular flashes of three-tenths of a second every three seconds, or five-tenths of a second every five seconds, according to adjustment, for a period of six to eight months, by night only, and without attention or assistance of any kind.

The sun valve, operating upon the principle that light is absorbed by a dull black surface, and that a metallic cylinder with such a surface may be heated and expanded thereby, while a polished cylinder by reflecting the light will be effected to a lesser degree if at all, and employing two such cylinders in a mechanical couple, are too delicately balanced and adjusted to indefinitely withstand the violent movements of a buoy during storms, and are accordingly not used thereon, but with a storage capacity of 150 liters, a buoy light will flash night and day for six months, at the end of which time the buoy must be taken up, cleaned, and repainted, and no additional expense or inconvenience is experienced in replacing the exhausted accumulators with freshly charged ones at the same time.

In addition to the lights above mentioned, 171 buoys, beacons, and day marks for the assistance of the mariner in entering ports, navigating narrow channels, etc., have been provided and the number is being constantly increased.

The cost of maintaining steel buoys in tropical waters is an item of considerable importance, and inasmuch as many of them are used to mark the edges and points of coral reefs, a standard concrete channel beacon consisting of a foundation block of concrete cast in a cavity blasted in the reef and supporting a reinforced-concrete shaft surmounted by a red cone or black cylinder of sheet metal, is now being used where feasible.

From the engineer's point of view the development and maintenance of this system of improvements has been a most interesting work. The problems encountered have been of perhaps as many different types as those encountered in any other country in the world.

At Manila, heavy breakwaters, piers, and walls were built upon a bottom into which borings have been made to depths of 200 feet below low water without penetrating material other than mud of various consistencies, with perhaps an occasional thin stratum of shells; into which it is estimated that the south breakwater of rubble mound construction, built in water 30 feet in depth, settled more than 15 feet under its own weight (520,000 metric tons) during and immediately following its construction; and into which Oregon pine piles, respectively, 100 and 80 feet in length were driven to depths of 125 and 100 feet below low water in the preparation of foundations for Piers 3 and 5 and for the retaining wall along the south bank of the Pasig River.

At Cebu, foundation piles for the new wharf were driven through a thin layer of a peculiar conglomerate resembling concrete, into a

very stiff clay below; while at Paracale, each of the reinforced-concrete columns supporting the pier deck rest in cavities blasted from the coral reef.

The Pasig River, practically a tidal stream for its entire length during three-fourths of the year, is subject to enormous floods during the rainy season, and to the peculiarity of flowing both ways at once from the mouth of the Mariquina River, when the water shed of the latter receives a heavy downpour of rain and reaches a height from which it discharges into the Laguna de Bay through the upper section of the Pasig River and at the same time into Manila Bay through the lower section, and incidentally sometimes leaving the



Channel beacon, Cebu Harbor.

Pasig River closed to navigation at the confluence by the formation of bars of gravel and sand.

The Cagayan River, an alluvial stream, with its source in the mountains of central Luzon, is subject to sudden rises of 40 to 50 feet along its upper reaches with sudden downpours of rain on the precipitous slopes of the upper portion of its watershed and at such times carries enormous quantities of silt, while the Iloilo River, a purely tidal stream, is being constantly filled up at its mouth with silt picked up along the south coast of the Island of Panay by the littoral (tidal) current, assisted by the waves generated by the winds of the southwest monsoon, carried thence through the Iloilo Strait to the river mouth at a velocity of more than 300 feet per minute, on a rapidly rising spring tide, and when diverted to the river, where the current velocity, since the enlargement of the channel by dredg-

ing, is barely one-half that without, is deposited in daily layers until navigation is interfered with and a dredge is sent to remove it.

At Cebu, although there is a strong current across the dredged area, reversing with the ebb and flow of the tide, its direction (approximately parallel to the sea wall and wharf lines) is such that little maintenance dredging is required.

The dredging and maintenance of Manila esteros requires the use of small (quarter-yard orange peel and dipper) dredges so constructed that their superstructures may be removed in order to pass under the numerous low bridges spanning these channels in all parts of the city, while the completion of the port district, Luneta extension, and Cavite Boulevard fills along the water front of the city, thus practically eliminating the available space for the discharge of material dredged from the harbor, together with the necessity for improving and maintaining other ports by dredging, has practically led to the discarding of the ordinary hydraulic dredge for work in the outer harbor and the purchase of the Fruhling system seagoing suction dredge, prepared to discharge either into dump scows alongside or into her own bottom dumping hoppers for transportation under her own power to the dumping grounds.

Aside from the limited funds available for the work, which has necessitated the accomplishment of the desired ends with the least possible expense, our designs have been further controlled by the voracious teredo infesting our waters and the anay or white ant infesting the land.

A few untreated Oregon pine piles used in the temporary construction trestle at Cebu were honeycombed and destroyed by the teredo before the concrete could be placed, though thoroughly creosoted piles of the same timber used in the fender system of the piers at Manila are still sound, so far as the ravages of the teredo are concerned, after six years in place.

The few native timbers that best withstand the teredo are difficult to obtain in pieces long enough and straight enough for use as piles in wharves for large vessels, particularly where the nature of the bottom is such as to require a penetration of 10 meters or more in order to sustain the loads to be imposed thereon, and these when, and if, obtained, being almost as expensive as concrete, has led to the adoption of concrete plain and reinforced for practically all marine structures.

The necessity for economy in construction has practically led to the discard of the gravity section sea or retaining wall, even where a back fill is desired, and the substitution therefor of reinforced concrete deck systems supported by various types of substructures, and of sufficient width to permit the construction of a cheap dyke of coral rock, beneath, with natural side slopes, to retain the back fill.

In this manner the new wharf at Cebu, with a deck 36 feet in width, was built at a saving of more than ₱100,000, or approximately 30 per cent less than a gravity section wall would have cost.

The use of a structural-steel floor system for the Manila piers was the result in part of the unknown possible effects of earthquakes, and of the fact that the saving in cost by using a reinforced-concrete deck would have been more than offset by the increase in cost of the foundation required to carry the heavier load.

Other projects built, or for which plans have been prepared, involve the construction of wharves paralleling the shores of small deep bays outside the typhoon belt, and where no further works of any kind, nor maintenance dredging will ever be required, as at Cagayan (Misamis) and Surigao; for the submarine blasting of ship channels through coral reefs with more than 100 feet of water on either side, as at Tagbilaran, Bohol; for the construction of both single and double jetties for guiding and confining the waters of both alluvial and tidal rivers, across bars of soft mud, volcanic and coral sands, and for protecting dredged channels from obliteration by littoral drift, etc.

In the design of lighthouse towers, stability against typhoon winds which have reached a recorded velocity of 120 miles per hour is required, while the heavy tower base shown serves the double purpose of increasing the arm about which the tower would tend to rotate, and of keeping the center of gravity of the entire structure as low as possible for stability during earthquakes.

"THE TOWN PUMP."

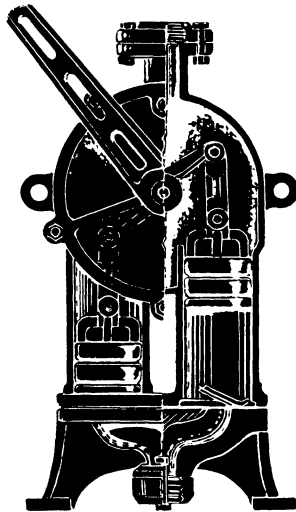
By J. W. VICKERS.

Many municipalities in the Philippines being wholly dependent on nonflowing artesian wells for domestic water supply, "the town pump" should be an item of considerable importance when municipal budgets are being made up.

Owing to the policy adopted by the Insular Government in 1910, whereby municipalities could have artesian wells drilled by guaranteeing the payment of one-third of the cost from municipal funds, wells have been drilled in many towns where such projects could not have been financed under less favorable conditions. In localities where flowing wells are common, the water-supply problem is quite simple as, after a well is drilled, and the curb and flow head completed, the

making minor repairs when needed, and the consequent necessity of sending to provincial headquarters or Manila for a man to do the work. Another factor contributing to the difficulties of pump maintenance is lack of the standardization of this class of equipment, as many as six or seven different kinds of pump being used in the same province, and in some cases two or three different kinds in one town.

Practically all of the several kinds and makes of pumps in use on our wells are well and favorably known among pump users in the United States and elsewhere, and have, as a rule, given general satisfaction when used for purposes to which each kind is best adapted. It is therefore obvious that none of them should be condemned because of their failure to withstand the unusual strain to which the average public pump is subjected. These pumps are usually purchased in Manila in small lots, and it often happens that the kind

**HEAVY DUTY HAND PUMP****DEEP WELL PUMP.
WORKING BARREL AND VALVES****SUCKER ROD JOINT**

water is available by placing vessels under the flow pipes and allowing them to fill. The water from such wells is distributed largely by regular carriers who peddle it from house to house at 1 or 2 centavos per can, the price varying according to the distance from the well.

Where wells are nonflowing, however, the problem is more complicated, as the average small town is not able to meet the expense of installing and operating a municipal pumping plant, and water users, in obtaining the daily supply, must pump it from the well by hand. That general use by the public of a hand pump is a most exacting test, is beyond question, and Government officials, Insular, provincial, and municipal, charged with the care of public pumps have with a few exceptions been unable to keep such pumps in working order more than one-half the time. This situation is due, principally, to the inability of municipal officials to secure locally the services of workmen capable, through even a partial training in mechanical lines, of

requisitioned for is not available, and some other style or make is substituted. This shortage in the local market accounts for the variety of makes and types of pump now in use, and together with the failure of local dealers to carry extra parts in stock contributes to the difficulties met by responsible officials in keeping municipal pumps in working order.

A satisfactory solution of the problem of pump maintenance obviously, involves (a) the standardization of pumping equipment, (b) training local workmen in each province to make minor repairs when needed, and (c) placing the responsibility for repair work in the hands of a responsible individual entity.

In connection with standardizing the equipment for pumping wells, it would seem advisable to limit the kinds used to two—a type of working barrel or deep-well pump, for use on wells in which the normal water level is 20 feet or more below ground surface, and a type of suction pump for those in which the normal level is less than

20 feet below surface. Included in the Bureau's plans for the fiscal year 1915 is a scheme to replace old pumps, as they become unfit for further use, with one of the two types mentioned above, and by installing the same kinds on new wells as they are completed, to gradually establish the two kinds used as standards of the respective types represented.

Training local workmen to make minor repairs to pumps in each province where a considerable number of pumping wells are in operation is a matter that will require considerable time and patience, but the results obtained by each of the three provinces wherein such workmen have been employed and trained under the supervision of the district engineers has been very gratifying, and in the opinion of the writer this plan should be followed by each province interested in municipal pump maintenance.

Placing the responsibility for pump maintenance is a matter on which there is, as yet, some difference of opinion, and several schemes have been proposed and considered by both the Executive Bureau and the Bureau of Public Works. The plan productive of best results to date, however, is for the repair work to be done under the direct supervision of the district engineers, the provincial treasurers, in such cases, paying the bills monthly and collecting corresponding sums from the municipalities concerned. This plan is now in operation in three provinces and is operating to the satisfaction of all interested parties.

RAISING THE BICAL BRIDGE.

By FRANK T. JAMES,

Associate Member American Society of Civil Engineers.

When the exceptionally high floods of the months of July, August, and September, 1913, caused the water in the Bical River, Ilocos Sur, to pass over the newly constructed bridge at an elevation more than halfway between the top of the curb and the balustrade handrail, an unprecedented height of water had obtained for this river. The highest water up to this time and within recollection of the oldest residents of the locality had been at about elevation +1.40 meters, and only on rare occasions, so constructing the bridge with the bottom of girders at elevation +1.70 seemed very reasonable and safe. (See Plate II.)

However, those 1913 floods brought about such changes in the course of the main channel of the river that at the normal wet season stages only three of the seven spans carried part of the flow while the greater amount passed south of the bridge and around one abutment, after tearing out the approach fill and damaging the abutment.

It was obviously necessary to increase the length of the bridge, if the original river spans were to be of any use to the public during the flood season, and it was also reasonable to expect that the high water reached by this season's floods would obtain in later years; so when the new spans were designed the elevation of the bottom of the girders was designated as 3.20 meters, or 18 centimeters above the maximum high water of 1913. Therefore the old spans had to be raised $1\frac{1}{2}$ meters. (See Plate III.)

The Bical Bridge was one of the four the writer had built in 1912-13, and he received the contract for the new work also. It consisted of seven 7-meter reinforced-concrete slab and girder spans on reinforced-concrete piles, with 4.27 meters roadway. Each slab and girders with balustrade and road metalling weighs about 45 tons. The river bed is dry during the months from November to June and is of hard sandy gravel and boulders, so it was possible to work directly from the ground and not from the pile caps or temporary piles. We planned to use, then, timber and lumber in sizes from 4 by 12 up to 12 by 12 and of varying lengths and screw jacks. The method of actual procedure is herewith detailed.

Looking at Plate I from the right, the balustrade of each span is built with the tar paper expansion joint and bronze rod between the large posts and the handrail on the far, or left hand, end. This means that to avoid cracking the balustrade or end posts, the span raised first must be that at the right.

A man with a 6-pound sledge hammer knocked out about 65

centimeters of the handrail—5 centimeters more than the length of the bronze rod—on the right end of each span and also the whole of the solid panel balustrade over the abutment walls as they had to come out to make way for the increased height of the parapets. A glance at Plate II will show that the outside girders on the end span were built close up to the inner faces of the walls with a sheet of tar paper between them—or a space of only a few millimeters between the two concrete surfaces. The front ends of the walls were knocked out down to the bridge seat as far back as the ends of the girders for the reason that if in raising the span one side progressed faster than the other the face of the encroaching girder would bear against the wall and undoubtedly crack, and perhaps seriously.

The road metalling was shoveled away from the end of each slab a distance back of 1 meter and then the concrete slab knocked out between the girder and back half a meter, thus giving four holes 1 meter by 60 centimeters over the pile cap to facilitate placing of supporting blocks and later the concrete for additional height of cap. The ends of girders and curbs were not chipped out as it was anticipated that the tar paper expansion joint was wide enough to permit the passing of abutting surfaces subsequent to slight lifting by jacks.

Preparatory to the work of actually raising the span, the ground underneath was cleaned of any loose large stones and, as shown in Plate I, two rows of 12 by 12 about 20 feet, one above and at right angles to the other, were placed level to carry the necessary blocking of various sizes—10 by 10, 10 by 12, 8 by 14, etc.—to reach an elevation within about 70 centimeters of the bottom of the girders. This permitted of placing the jacks— $2\frac{1}{2}$ by 16 inches—a working block, 6 by 8 or 10, 2 feet long, immediately on top of the jack and just short of touching the bottom of the girder by a couple of centimeters, affording a means of turning up the jack tight and the block bearing lengthwise the girder, before proceeding to lift the span. The working block was of the hardest wood obtainable—dugong—as when just beginning to lift the cap off, the jack sought to seat itself firmly in the wood before yielding effective pressure.

Ten jacks, $2\frac{1}{2}$ by 16 inches, of the ordinary screw type turned with bars of octagon tool steel $\frac{3}{4}$ inch diameter, 3 feet long, made up the lifting units.

One was placed under each of the outside girders 1 meter from each pile cap—not end of girder—one at each end of girder No. 2 and No. 4, $1\frac{1}{2}$ meters from the caps and under the center girder No. 3, as under the outside ones No. 1 and No. 5.

Various sizes of blocking were used as we had a lot of old pile-driver lumber on hand, so we sawed up the timber as desired, and took care to have the blocks immediately under the jacks, at elevations varying not more than 2 centimeters. In this way, if any of the lower grillage settled into working position when jacks were initially operated, there would be only about 3 or 4 centimeters at the outside of difference between the thread of the jacks when the span began to rise. The jacks had been well lubricated with ordinary axle grease and a little engine oil.

When everything on top and underneath the span was in apparent readiness the jacks tightened to just bearing and an abundant supply of small blocking 2 by 4 by 12 and 4 by 12 by 12 sawed and placed between each girder on the old pile caps, two strong laborers of ordinary height were placed at each of the five jacks on one end. They were obliged to take off their hats and not allowed to smoke any kind of tobacco, as at all times each man must use two hands. It is no idle joke to have a man try to turn up a jack if he has one hand busy handling a cigar or if he is looking around for an old hat he has had knocked off by the girder over him.

The boss carpenter, who was in immediate charge of the gang, then ordered each jack turned up slowly. It took a couple of half turns before the girders gave signs of leaving the caps, and required a genuine exertion on the part of the laborers so the two sides of the same end of the span rose practically simultaneously. This process continued until the girders were up an inch, and then the opposite end of the span was raised to same height. Inspection

was then made topside to see if the abutting girders slid past those of the next span properly and as to whether the outer curb line showed appreciable tendency of the span to slide or tilt sideways. If the latter condition obtained, the jacks on the side jutting out were raised a little more to bring it back to line and then if the ends of the girder were binding against the next span all the jacks were turned up a little more to alleviate it.

Then the jacks at the end last raised were turned up until the girders were 2 inches above at the cap and 2 by 4 blocking placed in underneath.

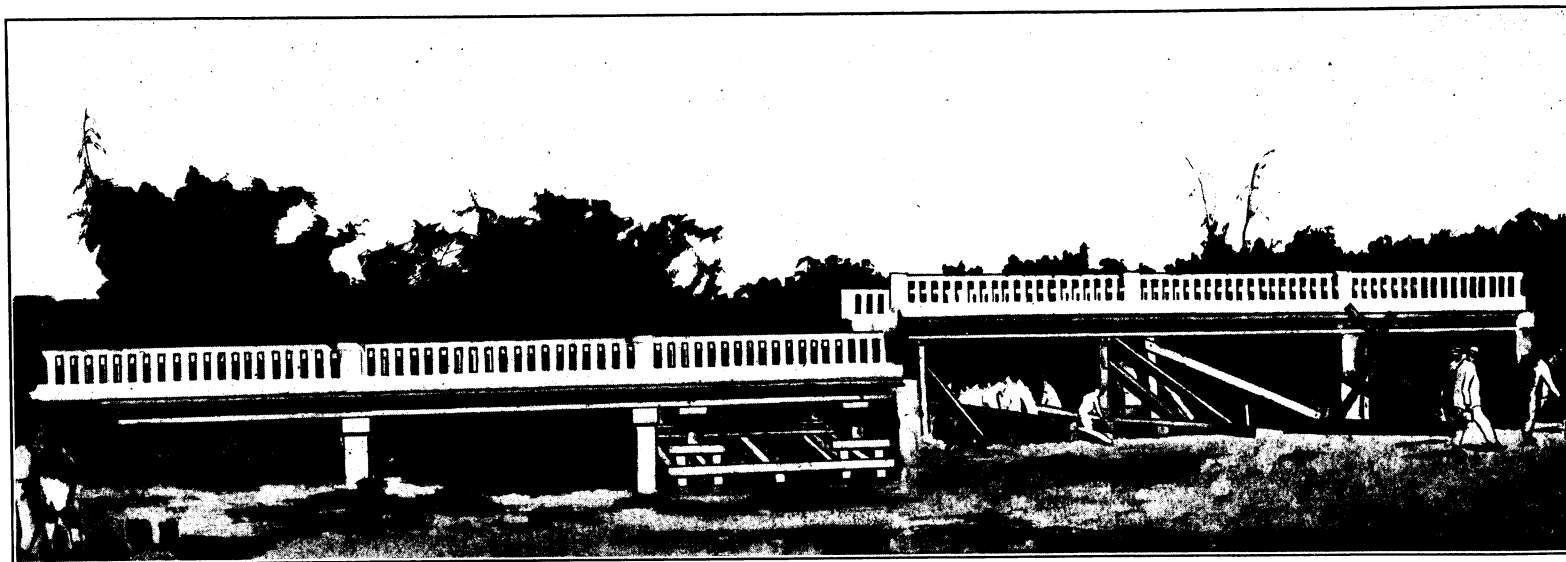
The jacks at the other end were then raised up to the 2 inches and the 2 by 4 put in. This process continued until the jacks had been turned up between 9 and 10 inches, in intervals of 2 inches, allowing the changing of 2 by 4 blocking for 4 by 12. Then the jacks were released and screwed down, more blocking placed underneath them and the process continued for another 10 inches only, to insure safety from possible buckling of the screw or stripping of thread due to possible eccentricity of loading if all were not turned simultaneously. Too much stress cannot be laid on the fact that care was taken at every 2-inch interval that the spans were not moving sidewise or longitudinally, particularly after the ends were clear of the next spans.

disturbances and we did not care to have those heavy spans sticking up in the air without concrete supports any longer than absolutely necessary. As it was, we experienced two rather severe earthquakes one night after three of the spans were up at the proper height and the concrete not yet placed on the second cap, as the form had been placed only late that afternoon. The second and third spans moved out about 1½ inches in the same direction at the joint where they butted against each other.

By placing an 8 by 8 brace up against the curb at this joint and driving a large wedge in between the end of it and the concrete of the curb we slowly moved the spans back into place.

The concrete was dumped into the forms from overhead through the four holes in the slab ends, and brought up to the bottoms of the girders which, as stated above, were a trifle above proposed new grade. This difference was necessary due to the shrinkage of the concrete which was placed quite wet. When the concrete had set seventy-two hours, the wedges were knocked out from under the supporting posts at the ends of the two spans resting above the new concrete and from under one post at a time beginning with an outside one and moving to the next one toward the other side.

In this manner the spans were let down very gradually and without shocks through a distance hardly appreciable. At first



Method of raising the Bical Bridge, Ilocos Sur Province.

The spans were to be raised 1.5 meters above the old caps and new concrete brought up that amount. Therefore, with a transit set up over one of the stakes for the outer line of curb, and used as a level the top of the curb at both ends was brought up to a few millimeters above grade and then lined in for direction. Blocking with thin wedges supported the ends of the span while the jacks were removed, and posts to support the span during placing and setting of new concrete were placed at each end.

These supports consisted of a 12 by 12 by 20 feet sill carrying five 8 by 8 or 10 by 10 posts—one for each girder 2 inches shorter than the distance between sill and bottom of girder. Wedges were placed between the posts and sill and posts and girder, driven in until posts entirely supported span and then toe nailed. Cross bracing of 4 by 12 was spiked to the posts on both sides of each row of supports, also longitudinally between the two rows at the ends. Then sway braces were nailed to the four outer posts and carried to heavy stakes driven into the ground at both sides the span. Plate I shows the method.

The blocking over the caps and that used for the jacks was removed to the next span and the process of raising continued as before. The top surfacing of the old abutment (right) was roughened, holes drilled for the dowel steel, and the steel placed, then the forms for cap extension lifted and bolted into place, and concrete run in as soon as possible. Ilocos Sur is in a belt of frequent seismic

it had been deemed advisable to raise the slabs to an elevation 5 centimeters above new grade and placing concrete exactly to grade, lower them into it, but we thought that it would be easier to get a level line of curb by working from the topmost elevation and when that was good, build the concrete to suit, as a difference of a centimeter or so in caps is not as noticeable as the same amount on the curbs.

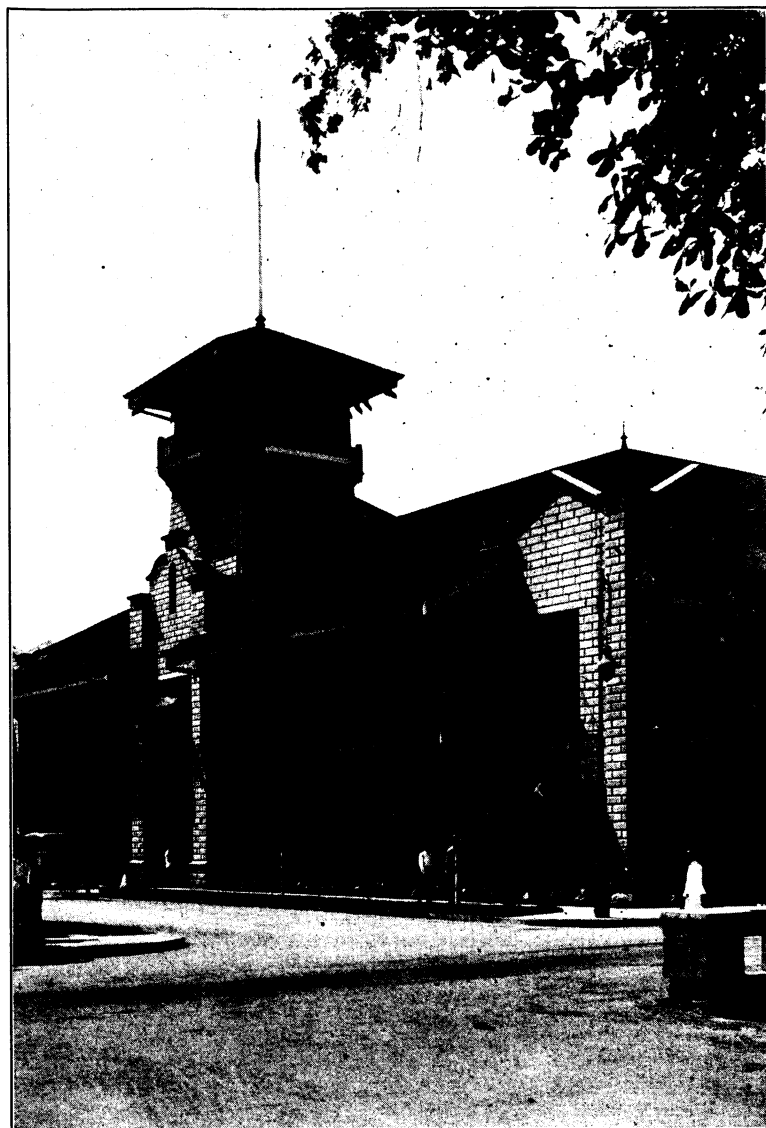
As fast as the caps were brought up under the two ends of two consecutive spans the joint between them was filled with grout, though the space was usually less than 5 millimeters and the tar paper unremoved. The slabs were repaired, waterproofed, and the surfacing replaced, and the balustrades closed. It required about a day to place the blocking and jacks, and a half day to start the span and raise it the first 30 centimeters. One more day's work usually yielded from 60 to 75 centimeters rise and the fourth day, the balance of the 1.5 meters and placing of part of the supports. Four weeks from the day when the boss carpenter arrived on the job (April 14) saw the six spans in their new positions and concrete added to all but the two caps upon which the last span had rested.

Although the application of the pressure from the jacks was from underneath and reversed the stresses in the spans, no cracks occurred in the girders, slabs, or curbs and hence none in the balustrade. Sometimes a slight crack occurred where the girders were dapped over the caps, but it was never over a couple of inches long.

PUBLIC WORKS, DEPARTMENT OF MINDANAO AND SULU.

By H. F. CAMERON, Member of American Society of Civil Engineers.

The territory of the Department of Mindanao and Sulu embraces all of Mindanao Island and the Sulu Archipelago, excepting the Provinces of Surigao and Misamis—being included between 4° 25' and 9° 50' north latitude and 118° 22' and 126° 40' east longitude from Greenwich—with an approximate total land area of 36,540 square miles, of which Bukidnon Province has 3,450, Agusan 4,630, Davao 8,150, Cotabato 10,165, Lanao 2,320, Zamboanga 6,725, and Sulu 1,100 square miles.



Facade of department building for Mindanao and Sulu.

Built by District Engineer C. F. Vance at cost of ₱200,000. Concrete block and hardwood structure with steel imitation tile roof.

The population of this territory is only approximately correct, as the country has never been thoroughly explored to permit of an accurate census. The population used officially in Mindanao and Sulu gives 300,600 Moros or Mohammedans, 192,500 Pagans or wild tribes, 109,000 civilized or Christian Filipinos, 3,000 Asiatics, and 800 Europeans and Americans, making a total of 605,900.

The law which created the Moro Province in 1903 also provided for a public-works department, having an executive and administrative head known as the "provincial engineer." This law further provided that the secretary of the different districts should be the deputy of the engineer.

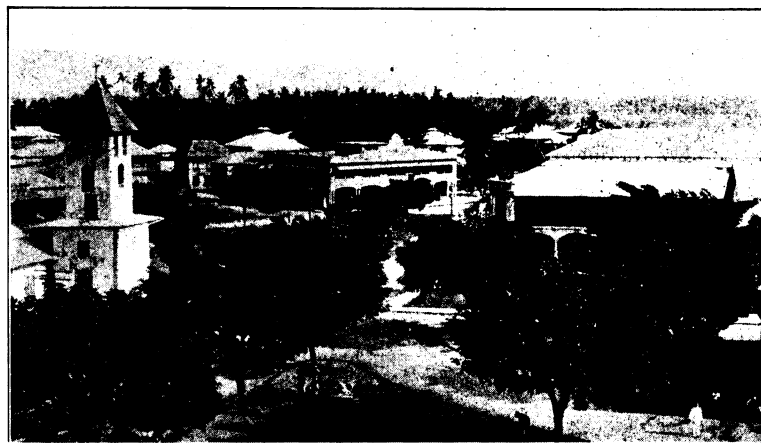
The public-works department at first was placed under the department treasurer for administration. Later, for economy and conven-

ience, the law was amended so that the office of secretary and provincial engineer were combined, and finally the office became known as the division of public works.

The provincial engineers, who at various times were in charge, are as follows: Capt. Chas. Keller, Corps of Engineers, August 15, 1903, to June 1, 1905; Capt. F. R. McCoy, Third Cavalry, June 9, 1905, to January 31, 1906; Capt. J. P. Jervy, Corps of Engineers, February 1, 1906, to August 3, 1907; Capt. W. B. Ladue, Corps of Engineers, August 4, 1907, to November 26, 1908; C. F. Vance, acting, November 27, 1908, to September 7, 1909; C. F. Vance, September 8, 1909, to July 31, 1910; Capt. Paul S. Bond, Corps of Engineers, August 6, 1910, to March 15, 1912; V. R. Stirling, March 15, 1912, to February 15, 1914.

The few laws for public works enacted by the legislative council of the Moro Province pertained chiefly to the upkeep and maintenance of the roads and bridges.

The first road law, which required ten days' labor of each male inhabitant, was found to be ineffectual for the reason that it was impracticable in many sections of the districts where the laborer lived to lay out roads and trails upon which to expend labor. After full consideration by the legislative council and upon the recommendations of the district governors, a new law combining the personal cedula



Zamboanga as viewed to north from tower of department building.

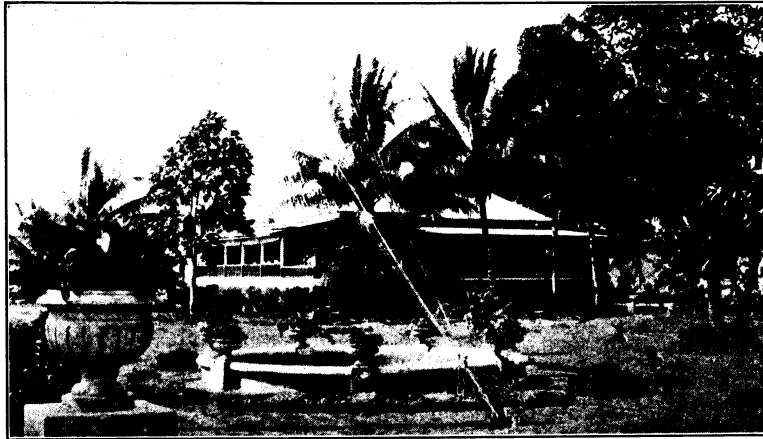
and the road tax was enacted. This law required every male non-Christian between the ages of 18 and 60 years to pay ₱3 annually, ₱2 of which was for the road and bridge fund, while ₱1 was for the general fund. All male inhabitants who paid the internal-revenue cedula were required to pay ₱2 annual road tax. Delinquent non-Christians were required to perform fifteen days' labor, while those delinquents who paid the internal-revenue cedula were required to perform ten days' labor upon the public roads and trails. This law was based upon the road law in force in the northern non-Christian provinces, where the principle of requiring ten days' labor or its equivalent in cash was maintained. The double cedula law of the northern provinces, which has been lately adopted in Mindanao and Sulu, has done away with the decapitation tax, as it was called, and its resulting evils.

Some of the features of the road law in force in Mindanao and Sulu are worthy of adoption in the northern provinces. One of the provisions provides that on provincial roads neither houses nor coconut trees can be located within 40 feet of the center line of road, the idea being to prevent accidents from falling nuts, a frequent occurrence, and to invite ornamental gardens in the space between the houses and the road limits. Another provision is that fences on provincial roads cannot be erected within 3 feet of the outside of the ditch, which gives additional room for improving the road appearance in many ways.

Data relative to the early execution of public works in the Moro Province are sadly deficient, as the methods of accounting for funds were changed several times in the treasurer's office, making it impossible to distribute these old expenditures to conform to present-day methods, and furthermore the reports are incomplete. However, an

examination of the old ledgers and trial balances in the department treasurer's office has permitted the compilation of a statement that tells the financial history of public works from the organization of the Moro Province to January 1, 1915: [See below, this page.]

The distribution of such a small amount of money for public works



Residence of the department governor, showing landscape gardening that forms part of Zamboanga beautification scheme.

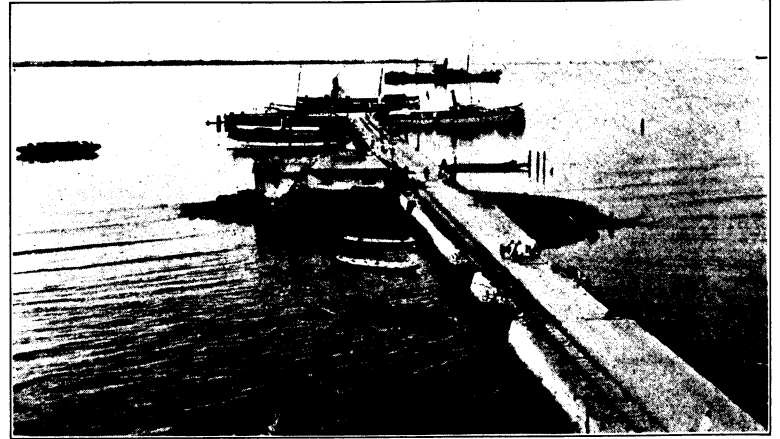
each year over such a large area, with every section of this area having a crying need for permanent works that must in a small way be satisfied, could have been no small task. When the public-works appropriation for a province did not average ₱50,000 a year, hardly the price of a good-sized permanent bridge or building, it is a wonder that there is so much in available public-works assets to show for this expenditure.

In roads and bridges there are none of first-class construction in the whole department. There are, however, approximately 90 kilometers of constructed second-class road (of which 53 kilometers are around Zamboanga), 199 kilometers of constructed third-class road, and 2,400 kilometers of trails scattered throughout the department.

Until 1912 no attempt was made to construct any bridges other than timber, and as a result most of the early bridges have failed

from fire, decay, or action of the white ant or teredo, so that many of the roads that should be termed third-class are impassable all the time and their construction value lost.

The few permanent bridges found are of steel or reinforced concrete and located around Zamboanga.



Zamboanga wharf, Zamboanga, P. I.

The two really large structures are the Iligan and Pantar suspension bridges in Lanao Province—the Iligan Bridge constructed during the American régime and the Pantar Bridge a reconstructed Spanish structure over the Agus River.

The estimated annual road and bridge revenues for the seven new provinces of the Department of Mindanao and Sulu are given herewith:

Province.	Cedula.	Land tax.	Internal-revenue refund.	Regular allotment.	Total.
Agusan	₱4,000.00	₱200.00	₱3,800.00	₱3,300.00	₱11,300.00
Bukidnon	4,000.00	200.00	3,800.00	3,300.00	11,300.00
Cotabato	11,400.00	600.00	8,000.00	5,200.00	25,200.00
Davao	17,000.00	2,800.00	7,000.00	5,300.00	32,100.00
Lanao	15,300.00	800.00	7,000.00	5,000.00	28,100.00
Sulu	16,300.00	800.00	9,500.00	6,000.00	32,600.00
Zamboanga	27,600.00	6,000.00	9,000.00	6,500.00	49,100.00

Public-works statement from the beginning of the Moro Province, September 2, 1903, to January 1, 1915.

	Fiscal year—											Total.
	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	
Personnel	₱4,338.03	₱11,819.99	₱29,810.26	₱14,552.10	₱16,161.59	₱16,320.67	₱16,065.52	₱13,767.62	₱28,158.95	₱24,524.24	₱17,460.93	
Office and miscellaneous	9,638.60	6,611.04	6,378.15	6,271.86	4,556.19	5,823.05	4,359.26	2,638.60	13,542.94	5,918.28	2,441.69	
Total	13,976.63	18,431.03	36,188.41	20,823.96	20,717.78	22,143.72	20,424.78	16,406.22	41,701.89	30,442.92	19,902.62	₱261,159.96
CONSTRUCTION.												
Roads and bridges:												
Zamboanga Province	10,709.80	46,709.86	42,775.47	5,901.66	25,028.59	50,781.36	30,430.25	43,804.10	75,952.48	14,689.96	3,726.63	
Davao Province			5,551.53	8,288.04		6,762.18	297.17	1,288.27	81,642.48	15,792.62	27,500.00	
Sulu Province			7,516.88	4,167.89				10,880.21	12,061.72		9,500.00	
Lanao Province		28,863.28	168,036.88	35,791.94	201.67	4,358.70	7,306.13	2,400.10	9,383.82	16,677.27	25,183.00	
Cotabato Province						2,350.00	3,196.64		2,195.95	4,910.86	21,000.00	
Purchase of equipment		52,538.19	3,821.64	73.50	1,566.85							
Total	10,709.80	128,111.33	227,702.50	54,223.03	26,797.11	64,252.24	41,230.19	58,372.68	181,236.41	52,070.71	86,909.63	931,615.63
Buildings	2,091.74	57,821.36	71,000.06	89,751.13	27,558.73	25,083.07	2,430.65	21,172.81	152,255.79	81,899.48	108,100.00	639,164.82
Wharves, sea walls, etc	10,035.85	11,692.96	28,996.09	168.09	1,982.65	29,946.42	18,269.21		44,795.84	16,168.00	17,000.00	179,055.11
Real estate			957.00	4,500.00	3,000.00							8,457.00
Miscellaneous constructions		787.25	376.20	220.63	519.73			1,278.80	25,641.35	47,552.31	25,045.95	101,422.22
Supply department		39,658.67	67,892.55	29,661.25	46,225.57							
Transportation		17,322.88	12,071.37	18,176.21	6,717.05							
Total		56,981.55	79,963.92	47,837.46	52,942.62							237,725.55
MAINTENANCE.												
Roads and bridges			11,164.40	11,980.29	19,319.29	20,277.72	20,553.79	35,806.66	56,393.71	52,645.55	64,100.00	292,242.11
Buildings						10,025.14	2,774.29	7,646.16	2,859.60	5,085.93	6,050.00	34,441.12
Wharves						7,990.38	2,858.99	8,536.49	28,951.69	3,518.79	1,000.00	52,856.34
Miscellaneous	1,143.14	9,054.25	7,379.07	4,043.91	9,921.35	814.50		52.15	6,315.47	8,632.04	8,501.00	55,856.88
Grand total	37,957.16	282,879.73	463,727.65	233,549.20	162,759.26	180,533.19	108,541.90	149,271.97	540,151.75	298,015.73	336,609.20	2,793,996.74

NOTE.—Due to the many changes that have taken place in department treasurers and the consequent changes that have resulted in distributions of expenditures a closer detail of work done was not possible.

Work on Overton-Keithly Road from 1905 to 1908, inclusive, also the purchase of road-making machinery for that period, was paid from congressional relief funds amounting to approximately ₱300,000. In 1911 about one-half of this road was abandoned for a new alignment, on the construction of which the military expended ₱90,000 of their funds. This expenditure is not taken into the above account.

Zamboanga and Jolo docks were constructed originally from military funds.

Fiscal year 1909-10 was the cholera year and very few public works were undertaken.

Fiscal year 1911-12 lasted eighteen months, from July 1, 1911 to December 31, 1912.

Fiscal year 1914 personnel, office, miscellaneous is for ten months and includes approximately ₱5,600 that was paid out to technical employees of the former régime in accrued leave and salaries that should have been taken up in previous years. The totals for 1914 are correct, however, subject to final adjustment when passing in audit.

With this small amount of yearly revenue it is easily seen that even the maintenance of the present roads cannot be given the proper attention.

The development of this country should not be considered from the viewpoint of its present revenues. It is above considerations of that nature, and until a fixed road policy is decided upon with continuing annual appropriations to carry this policy out, no advance can be made in road and bridge work.

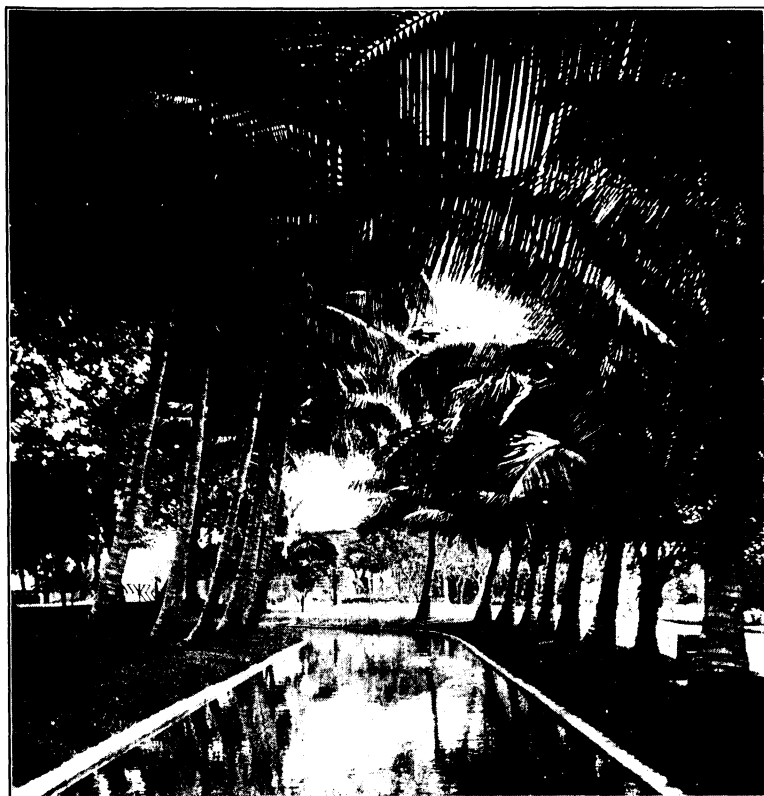
Much of the present work which must be maintained was not constructed with the money expenditures shown above, but rather by volunteer non-Christian or Pagan laborers who became imbued with the spirit and enthusiasm shown by many of the district governors in this work. These laborers have in some cases come long distances to carry on work from which they could never benefit. Great excitement and consternation took possession of the inhabitants of Cotabato when Datu Amputan of Maganuy, a rancheria 85 kilometers distant from Cotabato, brought in his followers to work out their road tax. The general conviction among the inhabitants was that Datu Amputan

Cauit River Bridge, Zamboanga-West Coast Road, Zamboanga Province, is a 20-meter steel truss structure, costing approximately ₱20,000.

Iligan Suspension Bridge, Iligan, Lanao Province, a 82.3-meter bridge, with steel cables carrying a timber deck. Towers are of timber resting on concrete piers. This structure cost ₱20,000.

Rizal Bridge, Dapitan, Zamboanga Province, a timber pile structure across a tidal river, with rock fill approaches. The total length is approximately 183 meters and the cost was approximately ₱16,000.

The Puluan Bridge, Dapitan, Zamboanga Province, is a combina-



Santa Maria Canal, the Spanish water supply for Zamboanga, as it flows through Pettit Barracks, Zamboanga.

had come in to police the community. There was no doubt that Amputan's 450 followers looked the part to the coast people, for they presented an ugly appearance in their strange mountain dress, with each man carrying a large two handed bolo (large knife) with which he was to cut the grass and brush through the jungle, a weapon too easily converted into a head axe. No joy reigned in that town until Datu Amputan and his laborers had departed for their rancheria (settlement) in the hills.

The more important bridge structures in the department are as follows:

Mataling Bridge, Dansalan-Lumbatan-Malabang Road, Lanao Province, a reinforced-concrete arch bridge 21.3-meter span, costing ₱11,000, built by the United States Army engineers.

Three reinforced-concrete bridges, named the Pitogo, Maasin, and Caragasan Bridges, on the Zamboanga-West Coast Road, Zamboanga Province, all reinforced-concrete slab and girder bridges of 8-meter span each, costing ₱12,000 for all.

Sininoc Bridge, Zamboanga-West Coast Road, Zamboanga Province, is a reinforced-concrete slab and girder bridge of 5-meter span costing ₱3,400.



Mataling Falls.

The falls are south of Lake Lanao, Lanao Province, midway to Malabang. The falls start with a sheer drop of 22 meters and are quickly followed by cascades giving an excellent opportunity for power development.

tion rock causeway and wooden pile bent structure, 260 meters in length across a tidal river. The cost was ₱18,000.

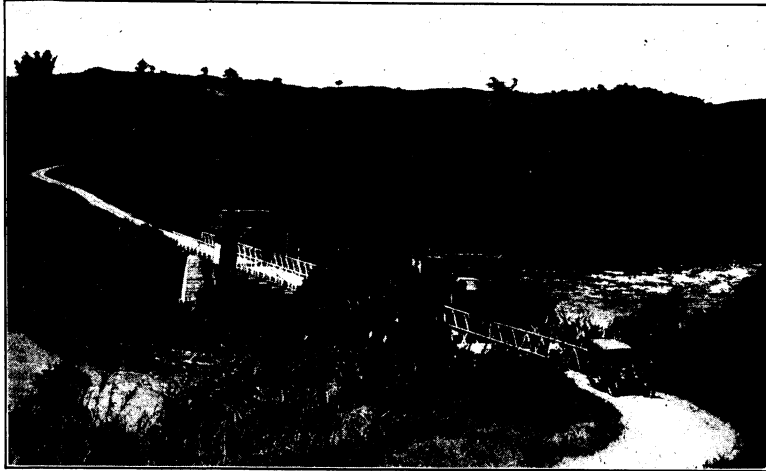
The Tamontaka Bridge, Cotabato, Cotabato Province, is a wooden pile bent structure with fill approaches about 60 meters long, costing ₱5,000.

The Dansalan Bridge, Dansalan, Lanao Province, is a timber through truss structure on concrete abutments spanning the Agus River at the outlet of Lake Lanao. The span is approximately 30 meters and the present value is ₱15,000.

The Pantar Bridge was originally a Spanish-constructed suspension bridge. The piers and towers are of massive lime masonry construction, while steel wire cables carry a timber decking. The present day value of this structure is ₱30,000.

BUILDINGS.

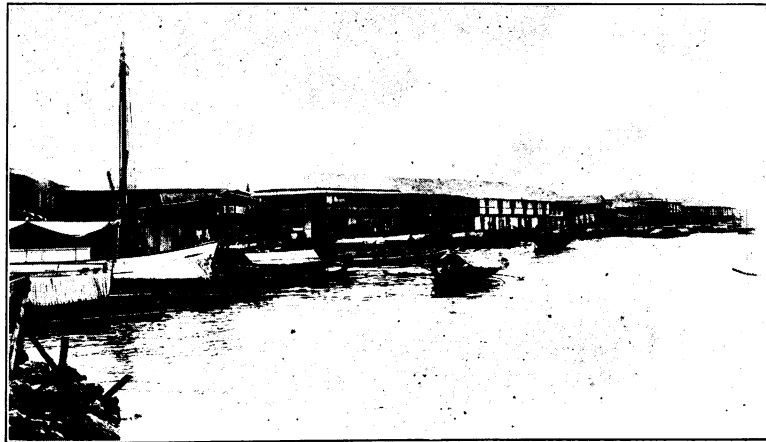
In building construction the same conditions prevailed as in road and bridge work, with the result that a large amount has been expended on timber structures that are no more or require a heavy annual maintenance expense to make them serviceable.



Pantar Bridge, Lanao Province. A reconstructed Spanish suspension bridge over the Agus River on Overton-Dansalan Road.

Until 1914, the only permanent reinforced-concrete buildings constructed in Mindanao and Sulu were those at San Ramon penal farm, the Dapitan and Iligan No. 3 plan standard school buildings, and the municipal building of Zamboanga amounting to ₱250,000. During the last fiscal year, however, a 10-room school in Zamboanga, a 10-room school in Jolo, and the district building of Davao, aggregating an expenditure of ₱110,000, have been added to the list. A complete list of the buildings constructed to date that are in actual use and worthy of comment is given herewith:

Department building, Zamboanga, Zamboanga Province, a concrete block and hardwood construction with steel imitation tile roof, cost approximately ₱200,000, including the construction of a concrete pump house.



Chinese Pier, Jolo, Sulu Province.

There are approximately 60 Chinese commercial houses constructed on piles over the water extending from the land end 111 meters into the sea. Probably 90 per cent of the export business of Jolo may be charged to this pier. This condition is somewhat forced because of the United States military ownership of all the water-front land where business firms would naturally care to locate.

District building, Jolo, Sulu Province, a reinforced-concrete first story and hardwood second story construction with a galvanized-iron roof, costing approximately ₱90,000.

Combination district and municipal building, Dansalan, Lanao

Province, constructed of hard woods for two stories, with galvanized-iron roof, and costing approximately ₱15,000.

Municipal building, Malabang, Lanao Province, a two-story wooden building with galvanized-iron roof, costing approximately ₱11,000.

Municipal building, Iligan, Lanao Province, a two-story building with galvanized-iron roof, valued at approximately ₱15,000.

Residence of collector of customs, Jolo, Sulu Province, a timber bungalow with galvanized-iron roof erected on square concrete posts over the water, costing approximately ₱8,000.

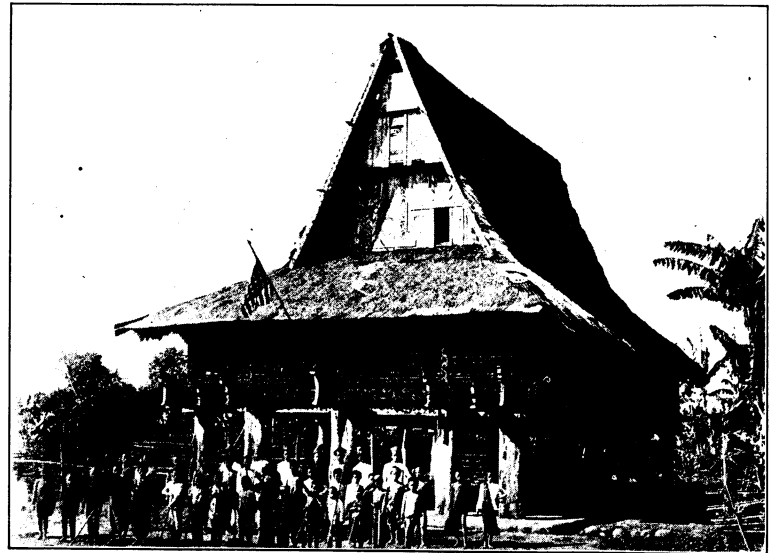
San Ramon penal farm buildings, Zamboanga, Zamboanga Province, all of reinforced concrete with cement tile roofs, costing approximately ₱170,000.

Lanao district jail, Dansalan, Lanao Province, a building with galvanized-iron roof having interior reinforced concrete cells but exterior wooden walls, costing approximately ₱12,000.

Municipal market, Jolo, Sulu Province, with concrete posts, concrete floor, and galvanized-iron roof, costing approximately ₱7,000.

Zamboanga municipal market, Zamboanga, Zamboanga Province, a steel frame building with galvanized-iron sides and roof and concrete floor, valued at ₱20,000.

High school, Zamboanga, Zamboanga Province, a reinforced-concrete school with galvanized-iron roof, one-half of a No. 20 plan, costing approximately ₱32,000.



Moro school, Dansalan, Lanao Province.

Jolo combined school, a reinforced-concrete building with galvanized-iron roof, about two-thirds of the No. 15 plan, costing approximately ₱30,000.

Dapitan school, Dapitan, Zamboanga Province, is a reinforced-concrete building, standard plan No. 3, with galvanized-iron roof, costing approximately ₱10,000.

Iligan school, is a reinforced-concrete building, standard plan No. 3, with galvanized-iron roof, costing approximately ₱10,000.

Dansalan hospital, Dansalan, Lanao Province, is a wooden one-story building with galvanized-iron roof, valued at approximately ₱6,000.

Sulu public hospital, Jolo, Sulu Province, is a wooden one-story building with galvanized-iron roof, costing approximately ₱9,000.

The district and municipal building, Davao, Davao Province, is a reinforced-concrete, two-story construction with a galvanized-iron roof, costing approximately ₱50,000.

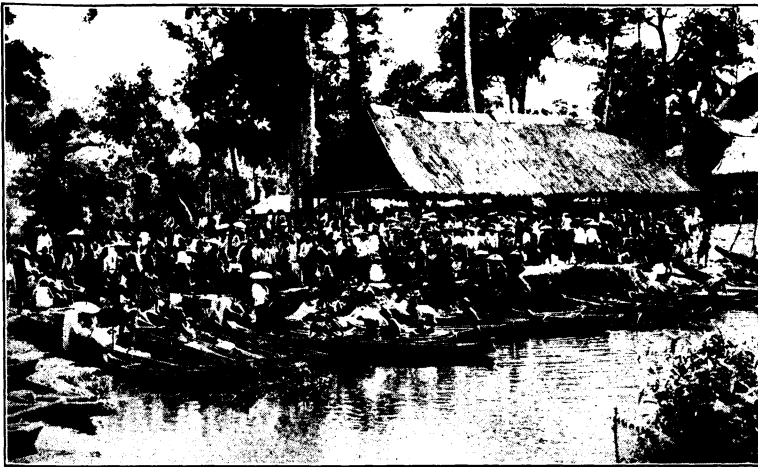
The municipal building, Zamboanga, is a two-story reinforced-concrete building with flat concrete roof, costing ₱55,000.

The Constabulary headquarters building at Zamboanga is a composite concrete-block first story and timber second story structure with galvanized-iron roof. It was constructed by the Bureau of Public Works by contract. The appraised value of this building is ₱30,000.

MISCELLANEOUS CONSTRUCTIONS.

Besides road, bridge, and building work many timber and rock fill docks and wharves have been constructed, water supplies installed, artesian wells driven, and telephone lines erected.

The wharves without exception are of timber decking on a pile bent



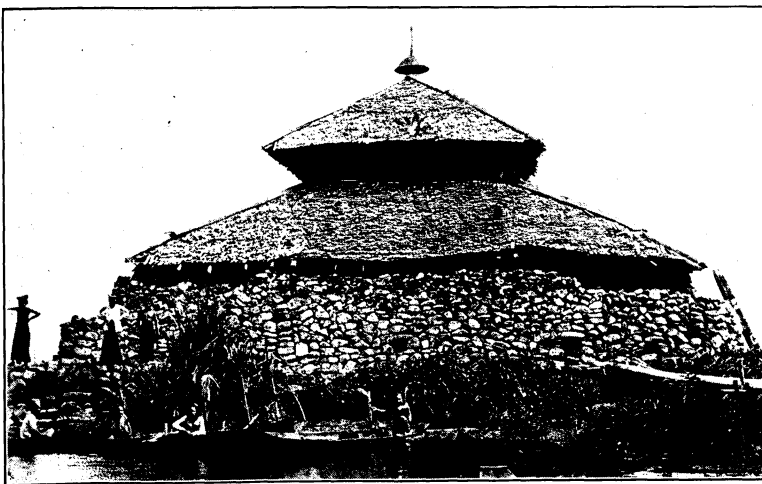
Moro market, Ganasi, Lanao Province.

foundation. The favorite pile is known as Luisin and comes in lengths to 70 feet and with a butt diameter of 20 inches. It does not seem to be teredo proof and has a bad fault in dry rotting quickly above the water saturation and breaking off easily, even capping not seeming to give any protection from this defect.

The principal wharves are shown herewith:

The Zamboanga wharf, Zamboanga Province, is a wooden pile structure with a rock causeway and pile bent approach 290 meters long—112 meters causeway and 178 meters pile bent—with an L head 40 meters long by 12 meters wide with about 7 meters of water off face of dock at low tide. It was originally built by the United States military forces and was reconstructed about 1910. The original cost was ₱54,200.

Davao wharf, Davao Province, is a timber structure on pile bents with a combination rock causeway and pile trestle approach to an L head wharf. The length of approach is approximately 300 meters



Mohammedan mosque at Bacolod, Lake Lanao.

with a 30-meter face. It is situated about 3 kilometers from Davao proper at the barrio of Santa Ana. Its original cost was ₱46,000, and its reconstruction cost, after partial demolition in 1910 by a bad storm, was ₱23,000.

The Jolo wharf, Jolo, Sulu Province, is a T head timber dock with a combination rock mole and pile trestle approach approximately

130 meters long. The face is approximately 53 meters long of which 23 meters was added in 1914. The depth of water off the head is about 9 meters at low water. This rock mole was built originally by the Spaniards and the timber head by the United States military forces. The value of the present dock to-day is approximately ₱70,000.

There are excellent timber docks at Parang, Cotabato Province, and at Overton, Lanao Province, built by the United States military forces.

The Parang dock has a rock fill approach to an L head. The approach approximates 120 meters long and the face of the dock is approximately 30 meters long with about 8 meters of water at low tide. The present value of this dock is about ₱50,000.

The Overton dock is a long pier about 40 meters long and 9 meters wide of rock fill and pile trestle construction. It has been demolished several times by the waves and reconstructed. The piles have been either creosoted or charred by fire, possibly both, and there are about 10 meters of water at end of dock. Its present value would be ₱100,000.

There are small timber docks at Siassi, Bongao, and Sitanki of wooden pile construction constructed by the United States military forces and kept up by the government of the Department of Mindanao and Sulu. These docks have a present day value of about ₱3,000 each.



Combination sled and cart constructed by Moros on Ganasi-Malabang Trail to harvest first crop of rice in fourteen years.

The few water supplies and wells in existence are described individually:

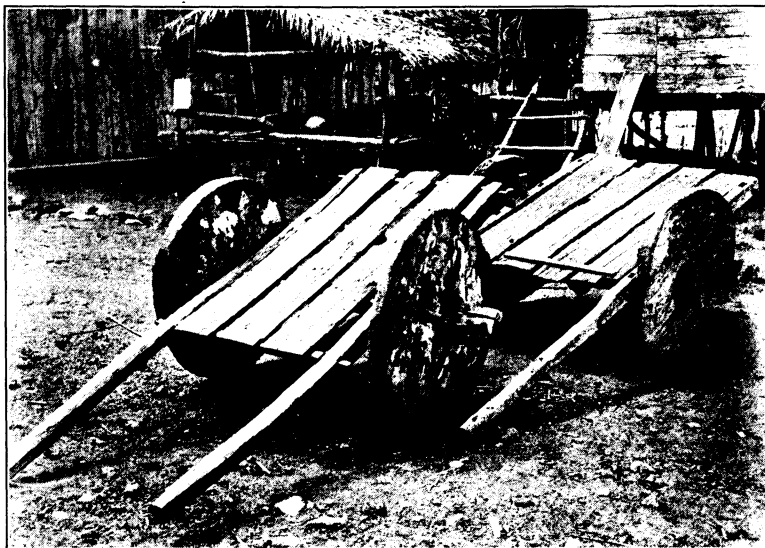
The present Zamboanga water works consists of the Santa Maria Canal which was constructed by the Spaniards. Its intake is on the Tumaga River, distant 7 kilometers from Zamboanga, and its whole course is through a thickly settled country and the center of the town. Very little or no precautions to keep it clean of pollution are taken, and the people and animals bathe in its waters, while many of the streets drain into the canal.

In Jolo there are two water systems, one by the United States military forces of a pumping plant located 2 kilometers from the town, which pumps water to a reinforced-concrete tank, holding 240,000 gallons located at an elevation of about 27 meters above Jolo. A 6-inch pipe takes the water to the walled city of Jolo. The other system is a municipal one that consists of a small lime masonry dam on the Tingkasan River, 3 kilometers from Jolo, and the water is conducted through a 4-inch pipe to the Moro barrio of Tullai, where the public obtains its water from the Corcuera Fountain. This system was built by the Spanish engineers before American administration. The appraised value of the municipal system is ₱10,000 and the military ₱30,000.

The town of Siassi has a municipal gravity water supply which was constructed by the United States Army forces. It consists of a small dam on a river, 7 kilometers from Siassi, that permits the water to feed into a 2-inch pipe line to Siassi where four or five public

fountains supply the people. The Vigan tariff of water charges has been made applicable to this system. The value of the system is ₱8,000.

In Parang there is a military system which consists of a pumping plant at river level that lifts the water to a steel tank approximately



Two types of carts used at Bongao, Bongao Island, Sulu Province, 4° 50' north latitude. Note the knee-brace support to axle in first cart.

90 meters above the pumping station. There is a pipe line through the municipality of Parang with house connections and hydrants for which the municipality pays ₱500 a month for a two-hour a day service.

In Camp Keithley, Lanao Province, there is a military pumping plant which elevates the water of Lanao to concrete reservoirs in excavation where it runs by gravity for the military service only.

At Camp Overton, Lanao Province, there is a gravity water supply which comes from several kilometers inland. This was installed by the military forces.

At Isabela, Basilan Island, Zamboanga Province, the water supply consists of a large lime masonry reservoir filled from springs. The people come for miles around in bancas to get this water.

Probably one of the most valuable of the undeveloped resources for the future of this department is the water power. The greatest of these is the Agus River draining Lake Lanao country. The area



Moro trail construction through rice country on Dansalan-Tamparan-Lumbatan Road.

of this lake approximates 150 square miles with a surface elevation of 2,200 feet (670.8 meters) above sea level. The Agus River is practically 17 miles in length, running mainly through deep rock gorges that offer excellent sites for hydro-electric development. There is one abrupt fall of 226 feet (68.9 meters), known as the Maria

Cristina Falls, located about 2 miles from the seashore that offers the finest site for economical development. No regular stream-flow readings covering any period have been taken, but recently readings on two stream sections of 700 square feet area at Lake Lanao outlet taken at the end of the dry season gave a current flow of 5 feet a second, or 3,500 second feet. This flow, with the increase due to additional rivers entering the Agus River, would allow for a 90,000 horsepower development on the Maria Cristina Falls alone. The topography at the outlet of the lake is such that additional storage works would be easy of construction. This development borders the largest timber concession of Mindanao and Sulu and should be a valuable asset in the development of this project where the water power might be successfully utilized in converting the great quantities of waste timber into paper pulp, alcohol, etc.

The Agus River, with its 140 miles, the Rio Grande with its 170 miles, the Mataling River and Falls, and the Tubay River draining large Lake Mainit, all have tremendous flows capable of water wheel or turbine development and practically cover the entire Island of Mindanao, offering fine advantages for irrigation, ore separations and treatments both from power or electro-chemical agencies, manufacture of nitrates, and for manufacturing or the conservation of the other natural resources which now are being wasted or not being developed.

The public works constructed in the Provinces of Agusan and Bukidnon have been under the Secretary of the Interior and now are under the Bureau of Public Works by Executive Order 71. In Agusan



The "Sausage."

Novel method for preventing river overflow on the Tumaga River, Province of Zamboanga.

some excellent schools, a good provincial building, several artesian wells, public baths, roads, etc., have been constructed. The artesian wells in Agusan Province are as follows: Four in Cabadbaran and two in Butuan, all flowing wells. All of these wells are protected with concrete work and the surroundings are sanitary. The four wells in Cabadbaran all have excellent drinking water, while of the two in Butuan one is brackish and only used for bathing and laundry purposes. There is an excellent concrete bathhouse and laundry connected with these last-mentioned two. Of the Cabadbaran wells, the one in the barrio of Cabangasan had a depth of 157 feet and a flow of 30 gallons a minute, while the one in the barrio of Calibonan is 166 feet deep and flows 38 gallons a minute, while another in the center of Cabadbaran has a flow of 35 gallons a minute.

Probably the cheapest and most popular means of communication has been the telephone. This line of communication combined with the postal telegraph and radio lines has received such an impetus during the past year that it is nearly possible to get in quick touch with any part of the department. It needs only an extension from Davao east to the Pacific to complete the communication.

At the end of 1914 a line had been opened across Basilan Island, two thirds of Jolo Island had been connected, and practically all of Lanao Province. The system installed is the grounded circuit using No. 9 wire and excellent results have obtained throughout.

POINTS OF INTEREST.

From the viewpoint of the tourist, the Department of Mindanao and Sulu has always been popular and the "trip to the southern islands" must be taken to complete one's knowledge of the Philippines.

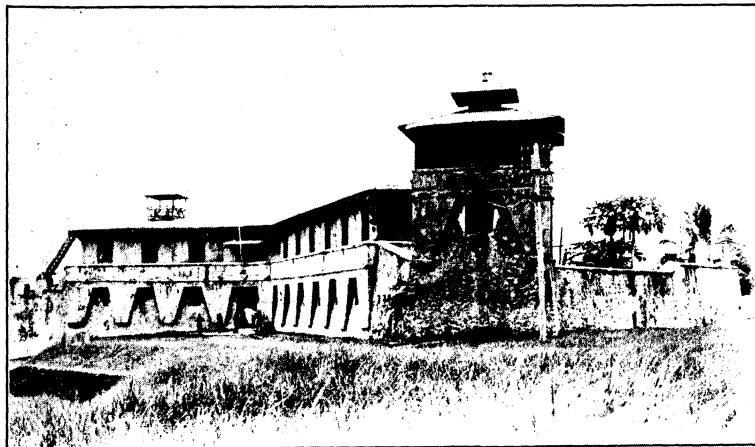
The best-known trips are those to the Lake Lanao country, Jolo, and Zamboanga, though the Davao Gulf trip is perhaps more interesting than either of the three mentioned, but is so far away in a transportation way that few ever get to see it as it should be seen—that is, to spend six weeks or two months visiting the different points of interest.

Lanao, with its 2,200 to 2,500 foot levels, is the Baguio of the south. It has all the beauties of the Luzon Baguio with the addition of a body of navigable water approximately 150 square miles in area.

The towns bordering its shores manufacture the Moro jewelry, brassware, beautiful cloths, mats, and implements that are sold throughout the Moro settlements of Mindanao.

The only draw-back to Lanao, which is common to all Mindanao settlements, except Zamboanga, is the lack of suitable accommodations for the general public.

Jolo, the only walled city of the south, has always been associated in the public mind with pirates, opium smugglers, juramentados, Jolo lanterns, pearls, and the beauty of its surroundings.



Fort Corcuera, Malabang, Lanao Province.

This was designed by the Spanish army engineers and is probably the most artistic fort in its design and setting of any in the Philippines.

The massive walls that were designed and constructed by the Spanish to withstand onslaughts from sea or land still remain as grim remainders of the days that have left their imprint on the public mind.

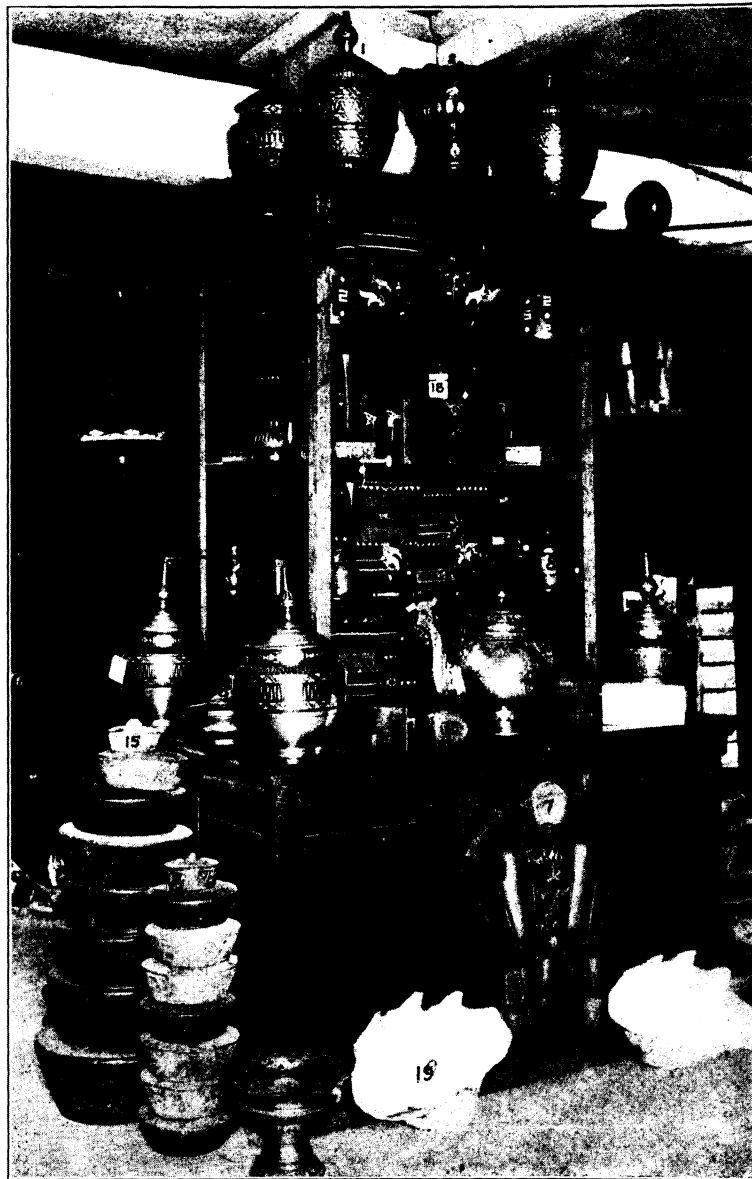
The streets are shaded by large and magnificent specimens of flowering and sweet-smelling trees that have attained an age when they must be slowly cut out and supplanted by a new growth.

The main points of interest are Chinese Charlie's store, the Chinese Pier, and an automobile trip to Indanan, Parang, or Maibun which is now possible.

Zamboanga with its attractive landscape gardening throughout the town and Pettit Barracks, magnificent marine gardens, and automobile drives into the interior or hill country, or along the pebbly beach to San Ramon penal farm still stands foremost in the beauty spots of the southern islands. One having spent a month in Zamboanga can never forget its sunset and moonlight picturesqueness.

San Ramon penal farm, with its smooth sea-gravel roads through lines of coconut trees, the reinforced-concrete bungalow type of buildings with their tile roofs scattered under the coconut trees, the tiny rivulets crossing the road here and there, the cultivated areas of corn, beets, and other vegetables, the herds of cattle, and the deer parks always call for admiration. This estate comprises 1,080 hectares of land of which about one-third is under cultivation—275 hectares in coconuts with 25,000 trees and 150 hectares in corn, vegetables, and pasturage.

This prison is very interesting and extremely modern in its design. It consists of a rectangular compound fenced with reinforced concrete and steel bar walls—the entire center section for a height of about 10 feet and for its whole length being composed of vertical bars on about 6-inch centers which permits free circulation of all the air there is. On the inside of the compound are constructed quarters in



Moro brass articles.

- (1) Garul guimuntiñan (chow or food pot). (2) Talagadan (fruit or flower bowl).
- (3) Palitaan (funeral lamp). (4) Gantang (rice or other measure). (5) Salapa (ornamental receptacle owned by people of class; fish-bone dish). (6) Habul panji (Moro dress of home weave). (7) Lamina (Moro armor of gold, silver, brass, and carabao horn). (8) Garul (small chow pot). (9) Salapa Dupun dupun (buyo or betelnut box). (10) Sili-sili (teapot). (11) Malucanlucan guimuntiñan (complete buyo set). (12) Paticuan (chocolate dish). (13) Languay (tobacco box). (14) Agong (gong, musical instrument, and medium of exchange). (15) Culintañgan (same as 14). (16) Ambung-ambung (ladies' work basket or knickknack box). (17) Sili (samovar or Moro hot-water kettle). (18) Ambun (complete buyo set). (19) Taclobo (Manankay, Jolo) (sea shell). (20) Baul (jewel box). (21) Pastan (complete set of buyo paraphernalia). (22) Tunkud (swagger stick).

exactly the same way as the walls except that a tile roof keeps out the rain while a steel grating attached to the roof plate and truss girders keeps the prisoners inside.

This prison has accommodations for 500 prisoners and is kept nearly full all the time. Of the 472 present inmates, about 70 per cent are trustees and allowed to work freely on the plantation.

To see Mindanao and Sulu one must visit Zamboanga. And to have seen Zamboanga well is to always retain the mental picture as expressed in "Zamboanga" by Susan Hart Dyer:

Zamboanga! Zamboanga
 With the moonlight on the sea,
 And the blue hills of Basilan
 Looming up mysteriously!
 Does the little darkling river
 Still go whispering thro' the town,
 Where strange southern stars are mirrored
 Thro' the palm-fronds peering down?
 Do the countless, shifting fireflies
 Keep their lamps alight for me
 In dreamful Zamboanga—
 (Zamboanga! Zamboanga!)—
 World—distant Zamboanga,
 By that moon-enchanted sea?

Credit for courtesies shown and information furnished is hereby given to John A. Hackett, owner of Mindanao Herald; to Charles Stark, department treasurer, Mindanao and Sulu; Gov. W. C. Bryant and Secretary E. S. Greene, Cotabato Province; Lieut. Guy N. Rohrer, P. C.; and Vicente Aldanese, collector of customs, Zamboanga.

ON THE JOB HERE AND THERE.

Mr. O. R. Kroel, an old employee of the Bureau, is at present in the engineer's office, Yellowstone Park, his duties being that of a principal assistant engineer to the Engineer Corps officer in charge.

Mr. B. von Schmeling, well known in the Philippine Islands as both district engineer and senior supervising engineer and who resigned from the service some months ago, has reentered the German army.

Mr. D. E. Henry, senior supervising engineer, now in the United States, will utilize his accrued leave by assuming charge of the Bureau exhibits in San Francisco.

Messrs. Keith, Grodske, White and Larson, old Bureau employees, are still engaged on railroad construction in China.

Mr. W. H. Waugh, senior supervising engineer, has resigned, effective at the expiration of his accrued leave, which he is now spending in the United States.

PROJECT NOTES FROM DISTRICT ENGINEERS.

ALBAY.

During the past quarter 4 kilometers of the Legaspi-Camarines Boundary Road have been resurfaced.

Plans have recently been received for the construction of two beautiful little 6-meter concrete arch bridges on the Guinobatan-Jovellar Road. Materials have been ordered and the construction will be done by administration.

Work on the Guinobatan School, plan No. 10, and the Camalig Market has been suspended awaiting the arrival of roofing iron.

Roofing iron was received for the Oas Market the 1st of December after a long wait, and the building is now practically complete.

A loan of ₱5,000 has recently been received for continuing trail construction between the barrios of Codon and Manombrag, subprovince of Catanduanes. This section of the trail is extremely rough and is the chief obstacle to prevent going by horseback from Virac, on the south end of the island, via Calolbon to Pandan, on the north end of the island. The new trail is being located on 6 per cent grades. In many places it follows around the coast and is being blasted from solid rock cliffs. Though rather expensive to build, it will be a very beautiful as well as permanent trail.

A recent report on work done on public buildings in this province since 1898 showed ₱217,000 expended for reconstruction and ₱433,000 for construction. The buildings reconstructed include the provincial building, the Constabulary barracks, the high school, the trade school, 3 schools, and 6 presidencias. Those constructed include the trade school extension, 28 standard schools, 4 blocks of tiendas, and 7 market buildings. No buildings costing less than ₱2,500 were included.

The estimates for the maintenance of the first-class road system of Albay Province for the year 1915 calls for ₱59,000 for regular maintenance and ₱50,000 for resurfacing. The system includes 126.4 kilometers of first-class roads and 7 kilometers of second-class roads,

making an average for regular maintenance of ₱442 per kilometer. It is proposed to resurface 21.2 kilometers at an average cost of ₱2,359 per kilometer. However, 5.4 of these are on the interprovincial road where stone is expensive and a heavy coat of resurfacing is necessary on account of the poor subgrade. Excluding those 5.4 kilometers, the average per kilometer for resurfacing is ₱1,234. The above estimates do not include the 8 kilometers of first-class road in Catanduanes Subprovince.

AMBOS CAMARINES.

A loan of ₱50,000 has been granted this province for the construction of a first-class road 6.5 kilometers long between Daet and its seaport, Mercedes. Daet is the center of an important hemp-producing country and heretofore all products have been handled on the Daet-Mercedes tramway, cart transportation being practically impossible except during a very dry season. Work will be started January 1, 1915.

Proposals for the construction of a standard type "A" market, 21 by 43.5 meters, in the municipality of Nabua, were advertised for. Bids were opened December 10, but as no favorable ones were received the municipal council authorized the work to be done by administration under the supervision of the district engineer. Work will be started January 10.

Dry weather and heavy truck traffic during the past two months have increased the maintenance expenditures considerably. The drought is so pronounced that less than 30 per cent of the rice land has been planted. The available labor supply has been greatly increased.

The Naga Market was accepted for use October 20. This is a type "A" building, 21 by 36.1 meters, constructed by administration at a total cost of ₱11,000. The municipality has sufficient funds for a duplicate building which will be constructed on the lower part of the market site.

Completion of the row of 12 double 4 by 6 meter tiendas at Iriga is delayed by the nondelivery of galvanized-iron roofing. Progress to date has been very satisfactory.

Excavation for the abutments of the Balos River bridge was started December 15.

During the past quarter, kilometers 43 to 47, inclusive, on the Naga Boundary Road, and kilometers 1 to 3, inclusive, on Calabanga Road, have been resurfaced.

The Anayan River bridge, a reinforced-concrete arch of 13.5-meter span, and the Marapon bridge, a reinforced-concrete slab and girder of 12-meter span, were opened for traffic during the month of December.

An inspection was made during the month of October of the Caramoan-Guijalo Road. This 5-kilometer section is maintained by a capitaz and two camineros under the direct supervision of the municipal president. The project is so isolated that inspections are limited to two or three a year. The road is kept in an excellent condition.

The reconstruction of the Tigaon-Salvation Road is about 90 per cent completed. This was an old Spanish road 5 kilometers long and barely passable for carts. The small culverts are being constructed of reinforced concrete, and fords are arranged on large streams. The road is surfaced with volcanic ash and gravel, materials obtained in the ditches of the road. Two per cent is the maximum grade on the completed section. The cost per kilometer, excluding culverts, runs about ₱2,250.

ANTIQUE.

The construction of the subgrade of the San Jose-South Road was completed to station 18+400 on December 10. At this point the new road joins the old Spanish road to Dao. Surfacing has been spread to station 16+500, waiting for the roller. The gravel used for surfacing this section of the road is taken from the Asluman River at station 14+000, which is a haul of about 2 kilometers by tramway.

Due to the flood during the early part of the year, the Antique River carried away about 400 meters of kilometer 7, San Jose-South Road, between Antique and Guintas. The river at this place changed its course, so that where the road was before is now the swift current of the river. To meet the situation a diversion road was constructed on the upriver side of the old road. The diversion is longer by about 100 meters than the washed-out road, but crosses the river at its narrowest point almost at right angles. The Antique-Guintas Diversion Road is now open to traffic and was completed on December 5 at a cost of ₱1,251.40. Total length, 700 meters.

The construction of the San Jose-North Road is being pushed as fast as possible. Due to the harvesting of rice in various parts of the province, labor is rather scarce. The subgrade ready for surfacing is now at station 26+300. Surfacing is spread to station

25+200 and is now being rolled. River gravel is used for surfacing, hauled by tramway about 2 kilometers. Special efforts are being made to secure carabaos and cows to be used for hauling, but so far without success, due to scarcity of animals.

The Pandan Culvert, standard plan 5 by 2 meters, was opened to traffic December 8 with proper ceremonies. Two bands headed the parade across the bridge, and speeches were made by the president and municipal secretary. They expressed their obligation to the Bureau and told the people of the importance of the bridge and of public works in general. The total cost of the structure was ₱2,676.17.

The municipality of San José has just applied for a loan for the construction of a water supply for the town of San José and also for the suburb of Antique. At present these places use well water and rain water for domestic purposes. If the necessary funds can be raised for the proposed project it will be the best blessing these places will ever get. Two artesian wells were sunk in different places in the town, but no good result was obtained.

A market site for San José has been surveyed and the project of constructing a modern standard-plan reinforced-concrete market and tiendas is now under consideration.

The sinking of artesian wells has been the talk of the municipalities of Pandan and Sibalom, and according to advices received, funds for guaranteeing one-third of the expenses will be included in their new budget.

Due to lack of sufficient funds, the gang maintenance of the second-class roads has been suspended temporarily.

Preliminary work on the Interprovincial Road through Capiz will be started early in the year. Pandan, the farthest north town in Antique Province, is 120 kilometers from San José, the capital, and on account of the many wide rivers between the two it is almost impossible to maintain direct communication between them by land. The road to Capiz Province will undoubtedly help Pandan by giving an outlet for its products by land. There is now an old Spanish road which will probably be followed for the present. Due to the evenness of the country from Pandan, however, a tangent 5 kilometers long to the foothills near the boundary will probably be tried, if this proves less expensive.

BAGUIO.

The construction of the Naguilian Road (Baguio-Naguilian Road) was reported 85 per cent completed November 30, 1914. The grading of the entire road will be completed by January 1, 1915, leaving a section of about 12 kilometers to be surfaced. The road will be in good condition for light traffic during the dry season and it is hoped to complete the surfacing work before the next rainy season. The portion of the road within the subprovince of Benguet is 34 kilometers long, while the old Naguilian Trail was exactly 36 kilometers long from Baguio to Ribsuan. A total of 11,500 lineal meters of the road has been graded by "paquiao" contracts at a cost of about ₱0.15 per cubic meter.

The Baguio improvement committee has approved of a plan whereby the Baguio Fair Association, organized for the purpose of beautifying the Burnham Park, would be allowed to construct a race track for horses, automobiles, motorcycles, and athletic meets in Burnham Park, Baguio. The contract for the necessary grading work, which is largely in accordance with the development plans for the park, was awarded by the association to Mr. J. O. Wagner, a local contractor, on October 5, 1914, for ₱0.50 per cubic meter for dirt measured in excavation. The contract involves the construction of a drainage ditch, 3.5 meters on the bottom and 1,200 long, and the excavating and placing of approximately 40,000 cubic meters of dirt in fills. The maximum haul is about 300 meters. Tramway equipment consisting of 581 5-meter rails and 90 6-meter rails and 24 cars, drag scrapers, bull carts, and wagons are being utilized in the work. Three eight-hour shifts of about 200 men each are employed on the work. The track for horses will be 24 meters wide and 1,000 meters ($\frac{1}{2}$ mile) long. The automobile track coincides with the horse track, except on the curves, and will be about 1,200 meters long. The outer half of this track is banked on curves to a slope of 1 to 6 which is reduced to a level track at a point 35° beyond the point of tangency. A grandstand of seating capacity of 1,000 people and a judges' stand is also being erected. The work is being done under the supervision of the city engineer and must be completed by December 24, 1914.

The hospital slide has remained practically dead during the past two months, a total settlement of 0.61 meter having been recorded during the period September 9 to December 14, 1914. The total settlement to date at a point just below the hospital building is 31.85 meters. No difficulty is experienced during the dry season in maintaining the section of the Benguet Road that passes over the slide. Practically the whole section is covered with planking made up of 3 by 6 inch boards spiked together in 20-foot sections

and any settlement that effects the road is overcome by raising the sections of planking and filling under to grade.

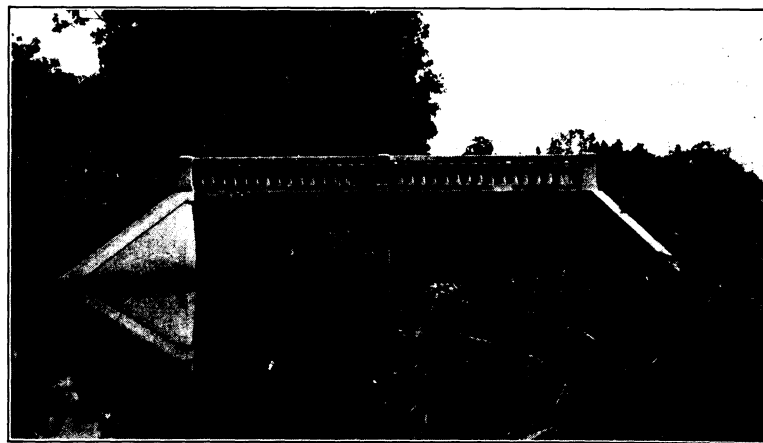
The sum of ₱15,000 was appropriated November 2, 1914, under Act No. 2415 for reconstructing the portion of the Hotel Pines building in Baguio which was condemned by the city engineer about a year ago. The building is owned by the Government and is leased to the Hotel Pines Company. A new lobby and dining room with floor areas of 15 by 16 meters, a writing room, and 22 bedrooms are provided for in the plans of the new addition. A contract for the furnishing of all labor has been awarded to H. C. Heald, Baguio, and the work is to be completed in sixty days. The addition will cost approximately ₱35,000, the Hotel Pines Company to furnish and pay for materials valued at about ₱20,000.

Act No. 2414, passed October 17, 1914, by the Philippine Commission, appropriated the sum of ₱15,000 for the temporary repair of bridges on the Benguet Road and authorized the Governor-General to declare that portion of the Benguet Road within the Mountain Province a toll road. Two 147 foot 6 inch Howe truss bridges are being rebuilt and temporary repairs being made on a number of other structures. There are 234 structures on the road which have a total length of 2,271.62 meters. Executive Order No. 100 provides for the collection of tolls on all classes of traffic over the road, beginning November 25, 1914, except that automobiles, trucks, and vehicles of the Army and Navy of the United States are exempted from the payment of tolls. It is estimated that the toll collections will amount to approximately ₱2,500 per month during the dry season, and it is hoped that the collections will be sufficient to maintain the road during this period.

One thousand four hundred twenty-three passengers and 68,838 kilos of express were hauled by the Benguet auto line during the period September 1 to November 30, 1914. The Benguet auto line discontinued hauling freight on October 21, 1914. This change in service was made necessary on account of the bridges on the Benguet Road having been declared safe for a maximum gross load of only 5,000 kilos. All freight to and from Baguio is now being handled by local transportation agents in bull carts, except that for the military which is being handled by military auto trucks between Dagupan and Camp One and by mule wagons over the Benguet Road.

BATAAN.

Three and three-tenths kilometers of the Balanga-Orion Road have been submitted for approval as a first-class road. Two and eight-tenths kilometers of this road have a width of 15 meters. The reason for not bringing the rest to that standard width is due to the enormous expense in moving large houses.



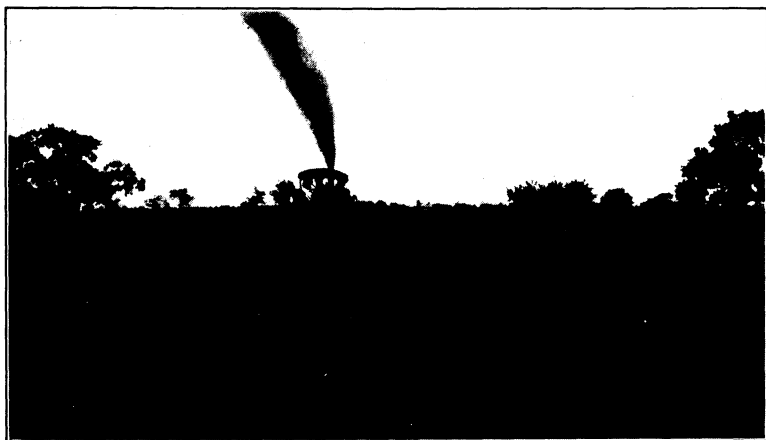
Culis Bridge on the Balanga-North Road, Bataan Province.

The instructions issued by the Bureau of Forestry for planting nurseries have been tried out during the last two months. A man was detailed on this work, and so far most of the small trees planted have signs of good growth.

The minor structures of the Pilar irrigation system are now under construction. It is very interesting to note that it was due to this irrigation system that the rice land in this section did not suffer whatsoever from the drought and as a result a good harvest was secured. The system has been used by the Rosauo estate sugar mill ever since after the first week of December.

The call for a better road from Balanga to Puerta Rivas is now answered. A new right of way was bought, and construction started the last week in November, so that before the middle of the following month all grading work was practically completed. The new road has a length of 1.2 kilometers. The reason for relocating the road

is due to the constant yearly caving in of the banks where the present road is, due to floods. The fund for next year provides a sum sufficient to complete the work.



A tangent of the new road to Puerto Rivas, Bataan Province.

Surveys for sites for standard markets in the towns of Orion, Balanga, Abucay, Samal, and Orani are under way, and site plan for each is soon to be submitted.

BATANGAS.

A small water storage and pumping plant recently erected on the Batangas government building grounds has aroused considerable enthusiasm among the local provincial and municipal officials. The plant was erected for the purpose of supplying water to the "gobierno," provincial jail and insane asylum, and to the provincial high, trade, agricultural, and domestic-science school buildings and to their grounds. The plant was built with a reasonable surplus capacity, but already demands in excess of this capacity have been made on it in the shape of requests from the municipality of Batangas for permission to pipe the water throughout the town for fire-protection and street-watering purposes, while a large number of private owners have indicated their intention of requesting permission to pipe the water into their houses for domestic use. The water is pumped from an artesian well and is clean, clear, and potable. The tank of 10,000 gallons capacity is 60 feet above the ground level, and is supplied by a steam pump which under test has pumped at the rate of approximately 72,000 gallons in twelve hours. The entire unit was fabricated and erected by the Atlantic, Gulf and Pacific Company of Manila.

The Nasugbu central school building, plan No. 10, and the Ibaan central school building, plan No. 3, are finished. The Tuy building, plan No. 4, and Mataasnacahoy building, plan No. 2, have just gotten well under way.

The Tanauan market building, a 30 by 43.5 meter "no-court-type" building is practically completed and will be turned over to the municipality very shortly.

Construction on the Batangas market building, a 68.7 by 24 meter, type B plan, will be undertaken by administration in the immediate future. In addition to this building two blocks of tiendas, each containing seven 4 by 6 meter tiendas, have already been started by contract.

The two first-class road construction projects in the province have been reopened with the advent of dry weather and work is proceeding satisfactorily. On the Tuy-Nasugbu Road approximately 3.5 kilometers of macadam have been completed since November 10, while on the Batangas-Ibaan Road approximately 3 kilometers have been completed in the same period. The work has been seriously handicapped by the lack of funds, the respective construction forces having been cut down to the minimum in order to make the funds last until January, when additional appropriations for these projects are expected.

Since last reported in the BULLETIN, five successful artesian wells have been drilled in the province. Of these, one in the municipality of Bolbok flows 20 gallons per minute from a depth of 600 feet, while the other four in the town of Batangas are all pump wells.

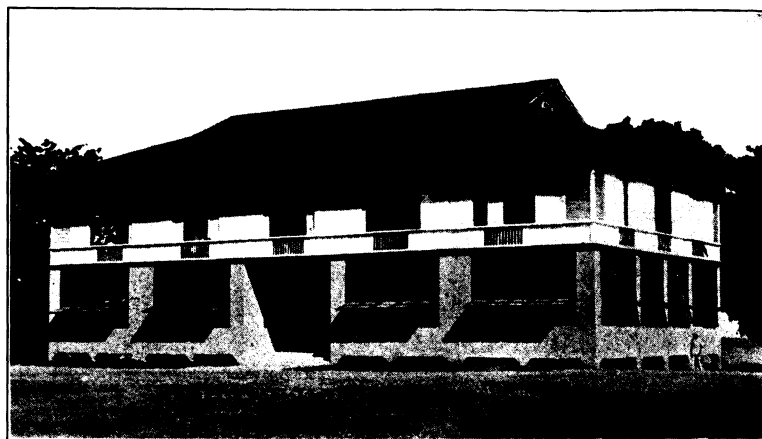
Funds have been provided for the Taal portion of the Taal-Lemery water system and the work is now being advertised. The system to be constructed will furnish ample fire protection and plenty of water for domestic use for the entire central barrio of Taal, while the pumping installation, which is to be a battery of two power and two pump units, so arranged as to be connected up in any combination desired, is to have sufficient reserve capacity to take care of the town of Lemery when the system is extended there.

BOHOL.

Work in general has been proceeding slowly recently, as appropriations for the calendar year 1914 have become practically exhausted.

The construction of the new section of the Tagbilaran-East Road near Guindulman has been suspended due to lack of funds, but it is expected that this section can be opened to traffic in January, 1915. Several culverts have been completed.

Work on the Loay-Interior Road has been proceeding slowly due to heavy rains. Bohol roads were damaged to the extent of about ₱2,000 by the typhoon of Thanksgiving Day.



Duero School after reconstruction.

The Duero school building has been completed, and the Batuanan, Cogtong, and Candijay schools repainted. The roofs of these latter were painted with De-co paint, as was also the roof of the Dimiao school. The Duero school has now the most complete plant on the Island of Bohol.

Investigation of the water system for Tubigon has been completed. This will be a pumping project, but there is a suitable tank site near the spring, which will minimize the difficulties of such a system.

The deep-well pump for the Tagbilaran water system has at last arrived and has just been installed. In as much as the water from this well has a much better taste than that of the well used heretofore, a great number of water subscribers is expected. This will materially increase the income of the system. The pump is a Gould make, with deep-well cylinder, 5½-inch diameter by 24-inch stroke, and is operated by a 4-horsepower Mietz and Weiss kerosene engine. The distance to the water is 100 feet.

BULACAN.

The San Ildefonso school building, a 7-room structure, has been completed and occupied. As the schools have been conducted in rented buildings of an inferior type, the opening of the new structure has added materially to the effectiveness of the school work done in this municipality.

Work on the north boundary section of the Manila-North Road will be completed about January 15, 1915. The Bigaa-Quingua section will be completed about the same date.

The route of the Manila-Tarlac Road has been changed so that it now branches from the Manila-North Road just north of the Quingua Bridge, kilometer 43.5, instead of at Bigaa as was formerly planned. The new route is only about a kilometer longer than the old route, and has been selected because it avoids the swamps which lie between Malolos and Calumpit as well as for the reason that the work required to make the Bulacan section first class will cost less than one-third of the amount estimated for the old route.

Some time ago plans for the extensive improvement of the Sibul Spring baths were prepared by the Consulting Architect. These plans called for the lining of these baths with a very high grade of tile which it was necessary to order in the United States. This tile is now being placed, and the other improvements are being made as fast as possible. Among other things, it has been necessary to raise the elevation of the water in the pool 9 inches. This was done with some hesitation as it was feared that such a course might reduce the flow of the spring, but so far as can be judged, there has been no material change in the rate of discharge.

The Ugong Bridge, a 10-meter through-girder concrete bridge, has been completed. This is a type of structure that has not been much used in the Philippine Islands, but its marked superiority in appearance over the lighter standard slab and girder bridges should make it a very popular type for future construction.

CAGAYAN.

The construction of the second-class road across the divide between the Cagayan and Rio Chico Valleys from an Insular allotment of ₱8,961, mention of which was made in the last QUARTERLY BULLETIN, has been completed for a distance of 6 kilometers and is now open for traffic.

Work on the Camalaniugan reinforced-concrete municipal building is now progressing satisfactorily. The foundation has been completed to the first floor and the walls are now being constructed.

The Peñablanca school building has been completed except the ceiling and room partitions, which will be put in when additional funds become available. The building is now being used.

The construction of the Tuguegarao-Alcala first-class road has now been completed to Estefania, 21 kilometers from Tuguegarao and within 16 kilometers of Alcala.

The road is being constructed for approximately ₱9,500 per kilometer, including reinforced-concrete pipe and rectangular culverts, which is considerably less than the estimated cost. Improved labor conditions, favorable weather, and efficient supervision are among the causes which have contributed to this gratifying result.

During the present year approximately ₱10,000 has been expended in the maintenance of second and third class roads. If the testimony of the traveling public is to be relied upon, the roads throughout the province are in better condition than they have been in years, and with the coöperation of the municipal authorities and the public for their conservation, they can be kept in still better condition. The abuses to which the second and third class roads in this province have been subjected in the past, rather than the ordinary travel for which roads are constructed, have caused some of them to become impassible or nearly so during the rainy season.

However, it is believed that the traveling public is becoming interested in better roads, so that it only remains to create public sentiment against the abuse of the roads, and probably in some municipalities to pass and enforce municipal ordinances.

CAPIZ.

During November and December road construction in this province has been at a standstill, due to lack of laborers during the harvest and shortage of funds at the end of the year. Bridge and culvert work has continued, however, on the Panitan-Pilar Road as well as between Tangalan and Ibajay.

Early in the new year the road to Ibajay will be completed and open to year-round traffic and some 5 kilometers first class will be added to the Panitan-Pilar Road.

A pressing need at this time is to replace three old wooden bridges on the Capiz-Libas, Calivo-New Washington, and Dao-Mambusao Roads with permanent structures. These will call for the expenditure of other than provincial funds and it is hoped to secure an Insular allotment for the work.

The Ibajay School (plan No. 7) will be finished and occupied in January. This building has 3-inch concrete partitions throughout. Experience proves that the 3-inch concrete partition is a difficult one to build. In this case a competent foreman has turned out a good job, but it is necessarily costly. It is believed that a considerable economy could be effected in this work without sacrificing quality, by using cement plaster on expanded metal lath instead of ordinary reinforced concrete.

A considerable amount of enthusiasm is noted in Ibajay and Navas of this province concerning the opening up of an interprovincial road from Navas to Pandan, Antique. Except for the exporting of the copra crop which goes direct to Manila, Pandan has practically all its dealings with the towns of the western end of Capiz. The present interprovincial route is over a well-located Spanish road, which has gone to ruin for lack of maintenance for the last twenty years.

The road is about 14 kilometers long. A small amount of labor, it is expected, will clear it and open up some sections to cart traffic, but proper reconstruction will require heavier appropriations. This road is destined to become an important route as it will afford an open port to Navas and Ibajay during the northeast monsoon and to Pandan during the southwest monsoon.

The building program for the coming year anticipates some three markets, a 6-room school in Pontevedra, a 4-room school in Panitan, 3-room schools in Ivisan and Pilar, and a 2-room school in the barrio of Agbalo, Panay; also a provincial trade school or domestic science building.

We invite investment in this province, by local capital or other, in motor transportation of passengers and freight. Draft animals are scarce throughout the province. This is virgin territory with good opportunities for development of automobile service on three routes, namely:

1. Capiz and surrounding towns with 42 kilometers of first-class

road and 20 kilometers of second-class road in connection. Capiz is a port and railroad terminal.

2. Dao and southerly towns, with 38 kilometers of first-class road in connection. Dao is the outlet of a rich rice-producing community and motor transportation is in great demand.

3. Calivo and all western towns, with 50 kilometers of first-class road. New Washington is a good all-year port and traffic between surrounding towns is heavy.

The district engineer will be glad to furnish additional information to parties interested upon request.

CAVITE PROVINCE.

After the bad storms and the three floods which caused so much damage to the roads in Cavite, an appropriation, or rather an aid, of ₱4,000 was secured from the Bureau for their repair. This was necessary as the provincial funds available were just sufficient for salaries and material to keep one caminero for each 3 kilometers of road.

The repairs consisted merely in placing new filler on the broken-stone roads and replacing the gravel on the gravel-surfaced roads and then rolling when the subgrade had thoroughly dried. Some 15 kilometers were repaired in good shape with ₱4,000. It is believed that the sections that were damaged are now in as good condition as ever. The main thing to do when roadbeds become softened by long and continuous rains and floods is to close them to all truck traffic and only allow half-loaded carts and carromatas to use them. Otherwise the subgrade is so soft that the stone surfacing is forced down into it causing the surfacing to lose its compactness and to unravel, which is the most serious injury to it.

Funds for maintenance have been so limited the past year that only one caminero per 3 kilometers was kept on the broken stone surfaced roads. As far as actually maintaining the surfacing in good shape, this one man was sufficient, but the right of way and sweeping over each day was neglected. By putting on an extra gang two or three times each year under a good capataz, the grass can be cut and the right of way cleaned up in general at a much less cost than placing one caminero per kilometer. In this way it is proposed to maintain the first-class roads during the coming year, 1915. Our available maintenance money is less than one-half the amount estimated or the amount which was spent in previous years. There are now 62 kilometers of first-class roads and approximately 32 kilometers of second-class that are maintained open to traffic the year around. The amount available for first-class has been ₱350 per kilometer, including the cost for repairs of the damages caused by floods, or ₱285 per kilometer for regular maintenance on the first-class sections. For second-class roads we had ₱6,000, or about ₱200 per kilometer.

These amounts will keep the actual surfaced sections in good shape if heavy traffic is stopped during periods of extreme softness of roadbed caused by rains, but will not allow any right of way improvements.

A No. 3 school building with all walls and partitions built of concrete and with concrete blackboards, like those used in Laguna school construction, is being completed in Dasmariñas. The appropriation is ₱7,500, but free transportation is given for materials in exchange for building the partitions and the porch wall of concrete.

Two good wells have been completed during the months of November and December. One in Dasmariñas and one in Imus. The latter is a flowing well, while the former has to be pumped.

We will probably be able to construct 5 or 6 kilometers of new roads during 1915 and the town of Cavite proposes to have the Bureau build 1 kilometer of concrete sidewalks and surface about a half kilometer of street for them.

CEBU.

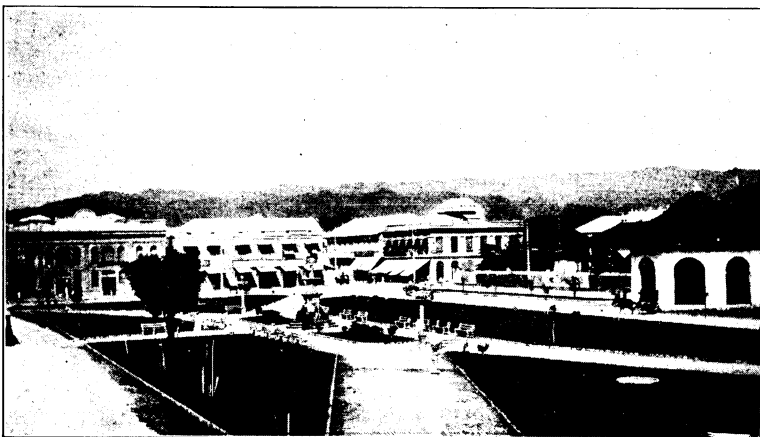
The construction of the Cebu-North Road has been discontinued until more funds are made available. The subgrade is completed as far as kilometer 70 and a light surfacing applied to kilometer 69. All traffic to and from the interior of the island in the municipalities of Catmon, Tuburan, and Tabogon now passes over this road. If it is possible to complete the road to Bogo in 1915, it will mean a tremendous increase in land travel between the northern towns and Cebu and will make a decided difference in the receipts of the Philippine Railway on their north line.

Surfacing on the Barili-South Road has been placed and rolled as far as kilometer 84+400 and the road will be declared first class to that point.

Construction work on the disinfecting building at the Cebu quarantine station on the Island of Cawit was suspended for a period of 1½ months. Work was started again on October 19 and the structure is about completed. The building has concrete walls and floor with a tile roof and is of a very substantial type of construction. It is being built by administration and will cost about 30 per cent less than the lowest bid received.

The 20-room Cebu Central Primary School has been completed. It was built by contract for ₱47,980 with concrete partitions and American ingot iron roofing. The amount paid for the building including extras will be approximately ₱49,649.54. The contractors, Messrs. Kipp & York, claim to have established a record for rapid construction work in the Philippine Islands. The contract was signed on August 14, 1914, and the building was completed ready for occupancy December 5, 1914, so the time spent on construction was just ninety-six working days. It is interesting to note that the next lowest bid was one hundred and sixty days, while some reliable contracting firms asked for almost a year in which to complete the structure. This building, unlike the smaller standard plans, has considerable ornamental concrete work around the front windows and a new type of handrail across the porch.

Considerable progress has been made during the past six months in tree planting of first-class roads. Some 98 kilometers of road have been planted with various kinds of trees, 39 kilometers being planted in coconuts, 58 kilometers in acacia, and 1 kilometer with lumbang. This work will be continued until all the first and a large part of the second-class roads are planted. It has been noticed that the problem of shoulder maintenance is almost completely solved when the road is properly shaded. Cebu, on account of her large population and relative scarcity of work animals and carts, has probably the heaviest foot traffic of any province in the Philippine Islands. This is especially true in the more congested portions of the island, very often as many as 1,000 foot passengers per hour pass along the road in some places. On shady stretches this traffic is easily kept on the metaling, but where no shade exists and when the surfacing is consequently very hot, it is almost impossible to keep the shoulder sodded.



Plaza Rizal, Cebu.

Two nurseries have been established in connection with maintenance stations on the first-class roads. The larger one is perhaps worthy of a detailed description inasmuch as it is probably unique both as to variety and equipment. A plot of land of 4,500 square meters in area was purchased near the point where the Talisay and Toledo Roads join the Cebu-South Road. A storeroom with a small office accommodation was constructed and the whole area, including 3,000 square meters of additional land that was leased later, was fenced with hog-tight netting. The storeroom is equipped with a complete outfit of tools and its location at the junction of three first-class roads renders it extremely valuable in cases of washouts, etc. Some 4,000 square meters of land were planted with acacia, lumbang, and ciruelas trees and an area of 3,000 square meters was devoted to coconut sprouting and other trees and plants. It developed very early that some means of irrigation would have to be devised as it was almost impossible to keep the rather larger area watered by hand. A small steam pump and boiler with a steel tank and wooden tower, all in use in Cebu City before the days of the Osmeña Waterworks, were installed, and a small distribution system laid out. It is now possible to keep all the plants well watered at a very small cost and the rate of growth of the trees makes it quite evident that the trouble taken in installing the pumping machinery was well worth while. Several varieties of trees in addition to the ones above-mentioned have been set out, as well as a very large variety of tropical flowers. It is intended to make the nursery as attractive as possible.

A maintenance station was also established at kilometer 30 on the Cebu-North Road and the land around the storeroom is used chiefly for coconuts. An attempt is being made to grow Benguet pine between Cebu and Toledo, as about 8 kilometers of this road averages something like 1,500 feet elevation.

Very great progress has been made in Cebu City in park improvements. Public plazas that were formerly used as feed lots and wagon

yards have been turned into very attractive formal gardens that are greatly admired by all visitors. This work has started a general movement toward lawn decoration, inasmuch as the local churches and colleges are beginning to clean up their grounds and numerous



A portion of 15,000 coconuts sprouted and ready to transplant, Cebu nursery.

private residences show signs of similar activities. This work on the plazas has been done almost entirely with prison labor and has been superintended by Mr. José Avila recorder of the provincial board. It has met with the general approval of all classes and has caused a great deal of favorable comment.

ILOCOS NORTE.

Work on the Pasuquin School, plan No. 7, is progressing satisfactorily. All concrete work will be finished by the end of December. Roof trusses are being assembled and joists for the floor being placed. This building will have wooden partitions, due to the fact that all the lumber is furnished as a voluntary contribution by people of the municipality. All the sand and gravel are likewise delivered to the school site gratis by the people.

The Laoag East Central School is progressing fairly well. The contractor, Mr. Daniel Galza, has all the concrete work, except the upper part of the gables, finished. The roof and floor are being placed, so that by the end of December all roofing and fully a third of the floor should be in place.

The Batac market, standard type B, 21 by 43.5 meters, is finished with the exception of giving the cement work a coat of neat cement paint. We are awaiting the action of the council for the approval of constructing standard sales tables for which there are sufficient funds. Considerable trouble was experienced with the roofing iron for this building which was received in two different lots from the Bureau of Supply. The pitch of the two lots was different which necessitated the making of wooden forms and repressing the ends of the sheets of iron to fit the roofing iron already laid. The building was built by administration.

The Laoag market and tiendas are progressing rather slowly. There has been so much delay in waiting for the iron and steel. The main market building, standard "no-court type," 30 by 43.5 meters, has all columns up as well as all rafters and purlins on the "lean-to" part, but no iron is available for the trusses of the central part of the building. The contractor, Mr. Daniel Galza, has gotten all dimension lumber locally; only the surfaced lumber has been ordered from Manila.

The municipal council of Laoag has asked for a change in the plans, requesting a substitution of block C, 4 by 6 meter double tiendas, for block A, 4 by 4 meter single tiendas. This substitution has been asked for on their part for the reason that to build the block A single tiendas would require demolishing a set of old brick tiendas which are drawing a monthly rental of ₱8 each. The block C tiendas will be located in an open space of the market lot and will thus cover unoccupied ground.

Work on the reconstruction of the Bacarra Bridge has begun. It is proposed to use all native lumber on that part of the structure that will span the south half of the river. The structure is of the usual collapsible type of deck bridge in so far as the first 10 bents of the bridge are concerned. The 6 additional bents will be supported on sawhorses in place of the usual pile bents. This type has been chosen for two reasons: First, because of cheapness and, second, it is believed that these bents can be moved to fit the change in the channel of the river at a much smaller cost of construction than pile bents and serve the purpose equally as well.

ILOCOS SUR.

On account of having an open rainy season this year no damage was done to first or second class roads including bridges in this province, except what can be properly taken care of by the regular maintenance system.

From September 15 to December 15 of the present year, 10 kilometers of subgrade have been constructed on the Santa Cruz Diversion Road, which is 13.48 kilometers, the work being done under contract at a cost of ₱1.17 per lineal meter. This includes forming the roadbed, slopes, ditches, and a dike 50 centimeters in height on the 15-meter right of way, which separates the road ditches from the surrounding country, and which serves very nicely for the purpose of planting trees along the road, thereby defending the right of

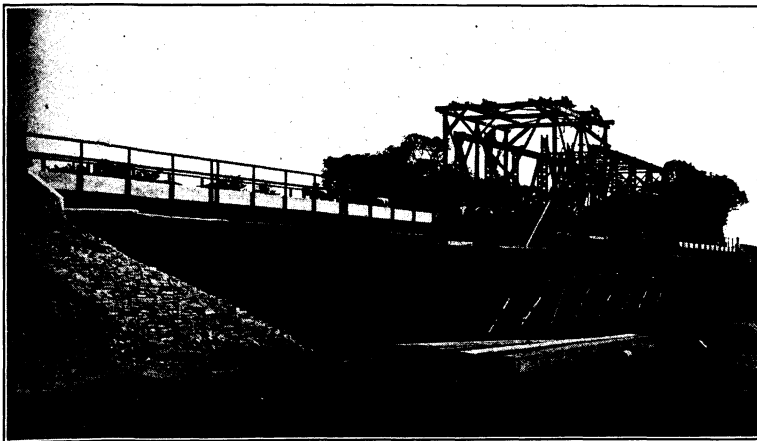


Project No. 8. Construction Vigan-South Road. Incomplete; first course stone placed and rolled only.

way of the road. The experience that the district engineer has had in this and other provinces has taught him not to try to let contracts to the laboring class of people by cubic content, but by lineal meter, which they seem to understand better. The actual cost per cubic meter, including forming roadbed, slopes, ditch, and dike, is ₱0.21.

The subgrade for this section will be completed on or about January 31, 1915, and it is expected that the road will be entirely completed on or about May 30, 1915—that is, if the amount necessary is made available. The road is being constructed in accordance with plans approved by the Director of Public Works.

Two kilometers of road have been completed on the Vigan-South Road between the municipalities of Candon and Santa Lucia. The road has a 15-meter right of way and is being constructed in



Project No. 11. Construction of Candon Bridge, Ilocos Sur Province.

accordance with plans approved by the Director of Public Works at a cost of ₱4,000 per kilometer, completed. To connect the above-named municipalities it is necessary to construct 3 more kilometers. When this is done it will connect up with the Santa Cruz diversion.

One and a half kilometers of trail between the municipalities of Bangued and La Paz have been converted into a second-class road.

Kilometer 1 on the Bangued-Tayum Road has been constructed into a first-class road. Total cost, including surcharges, ₱2,829.79. This kilometer was constructed in accordance with standard plans approved by the Bureau of Public Works, first-class road, with a metal section of 4.27 meters. No rolling was done, it being an utter impossibility to get a roller into that section of the country, as it is very mountainous and there is no road which connects the Province of Ilocos Sur with the subprovince of Abra.

The construction of a three 7-meter spans bridge with a 4.27 roadway over the Sinabaan Creek on the Manila-North Road has been completed, the bridge being under contract to Messrs. Allen and James. The contract price was ₱7,530, and the total cost, including extra labor, inspector, miscellaneous, provincial and Insular surcharges, amounted to ₱8,373.36. Work was commenced July 1, 1914, and completed October 6, 1914.

The Candon Bridge is nearing completion, everything being finished with the exception of the concrete floor.

ILOILO.

There have been installed in the market recently completed at Santa Barabara 60 yacal market tables. These tables are movable and convenient and are giving excellent satisfaction. They were built by administration and cost about ₱10 per lineal meter for tables 90 centimeters wide by 400 centimeters long.

Calle Legaspi from the Muelle to Calle Progreso is being resurfaced with crushed limestone, making another first-class street in the shipping district, which will greatly relieve the congestion in that quarter.

The resurfacing of Calle Iznart from Plaza Gay to the provincial building has just been completed. This makes one of the finest streets of any city in the Islands. The rock used is a fine-grained black basalt which stands abrasion remarkably well, so that the maintenance cost is expected to be a minimum. Calle Real, constructed of the same material over eighteen months ago, is to-day in perfect condition, although carrying the heaviest traffic in Iloilo, and this, too, with practically no maintenance.

Work on the Iloilo Central School was started about November 1 and at present writing is nearly half completed. Most of the concrete is in place and the carpenter work is progressing quite rapidly. It is expected that the building will be ready for occupancy before May 1, and that the cost will fall well within the estimate and considerably below the lowest contract bid.

The Ice Plant Road has been completed from La Paz station to the Standard Oil bodegas, thus giving access to a large territory which formerly had no outlet except by boat.

Work has been started by W. H. Lambert on the Molo jetty contract and will be steadily pushed until the weather makes it impossible to work. The rock being used is nearly all ton rock and the contractor is making good progress. It will be a very handsome piece of heavy riprap construction.

Work has begun on the Molo market. The contractors, O'Leary & Burns, hope to complete the job in less than ninety days, although the contract time is one hundred and thirty-five days. This market will be 24 by 42.8 meters, of the B type, with red tile louvers, etc. It is located on the most prominent corner in Molo and will, when completed, present a very handsome appearance.

A new Malthoid A grade roof is being placed on the provincial jail. It is hoped that this will eliminate any further trouble with leaks in the jail roof.

A reconnaissance has been made with a view to securing a water supply for Iloilo from the Island of Guimaras. Mr. Heise of the Bureau of Science has investigated the water and found it potable. Weirs have been constructed and stream gaugings will be carried on for the next six months.

Four kilometers of the Lucena-Jalaur Road have been completed and put into first-class shape. A soft limestone from the Dumarao quarry has been used as a binder with the gravel from the Santa Barbara pit. The combination gives excellent results.

An investigation for the substitution of a steel bridge in the place of an old wooden bridge on the Pototan-Dumangas Road was made in November.

Surveys have been made for market sites in Janiuay, Maasin, two sites in Dumangas, two sites in San Miguel, one in Banate, and one in Guimbal.

The reconstruction of the San Miguel-Leon Road was again taken up after the rains. Three kilometers are in fine shape and the work is being pushed rapidly.

The contract for the construction of the Barotac Nuevo market was awarded to O'Leary & Burns.

The contract for the Dumangas presidencia was awarded to Ong Pao and the work is well underway.

ISABELA.

With the new loan of ₱40,000 to this province, the construction of the Cordon-San Luis Road will be completed. Only 4 kilometers are left to be built. Surfacing with gravel, using volcanic earth or rotten rock as binder, is now in progress. At the places where concrete box culverts are proposed, American ingot iron corrugated culverts will be used. This substitution is adopted for economy's sake as the cost of the hauling of material, such as cement and reinforcing steel, is very high, and the gravel and sand found in the locality is not of first-class quality. The temporary bridge at Ilut Creek is almost completed. Grading on this whole section will probably be finished by the end of February, 1915. The cost of grading is ₱0.71 a cubic meter, excluding surcharges.

Half of the above-mentioned loan will be used for the construction of the Ilagan-North Boundary Road. With this amount, plus the balance from Buyong Bridge (₱1,000 approximately), kilometers 3, 4, 5, 42, 43, and 44 are expected to be built. The first 3 kilometers are located between Ilagan and the Rugao Bridge, the other 3 between the San Pablo Bridge and the north boundary.

For next year another project will be opened, the Ilagan-South Boundary Road. As the construction can not be started from the beginning of the first-class road at Angadan, due to a proposed 6 kilometers of diversion line from the present road, the work will be started at the south end of Cauayan and will proceed toward Angadan.

A road 1.8 kilometers long from Cauayan to the river landing at Tarayum will be reconstructed into a first-class road, the cost of the work to be borne by the municipality of Cauayan, and the maintenance of same will be met from provincial funds.

In all probability a 7-room school building at Echague will be constructed in 1915, if a ₱5,000 loan from the Insular Government to the municipality of Echague can be secured. This loan, with ₱9,000 Insular and municipal funds and voluntary contributions, will make a total of ₱14,000. However, it has been suggested that while waiting for the loan, the construction of an inclosed structure should be authorized, so that requisition for materials can be made and delay avoided due to low stages of the Cagayan River.

The final work on the Rugao Bridge, the painting of the steel structure with approved De-co compound, was done in November. The dedication took place on October 4, 1914, in the presence of the honorable provincial board; Insular, provincial, and municipal officials and employees; property owners and merchants of Ilagan; and the whole caminero force of the province. Speeches were delivered by the provincial governor and the Assemblyman. There were songs by school boys and girls, baseball games, and the caminero prizes were awarded.

On account of the heavy losses due to frequent fires in Ilagan, a scheme has been suggested to the municipal council of Ilagan for supplying the town with water for fire purposes. This scheme consists of installing a concrete tank on Agricultural Hill, from which water will be conveyed by gravity through galvanized-iron pipe tapped at every street intersection for fire hydrants. This tank will furnish water for the Centro, San Vicente, Bacolod, and Santa Barbara districts. Another tank, smaller in size, will be located at the back of the church, and this will furnish water for the Bagumbayan district. If this scheme meets with the approval of the municipal council, plans and estimates will be prepared and submitted to the Director of Public Works. It is expected that funds can be raised from municipal and provincial sources and by voluntary contributions from house owners. Investigations and surveys on Upi Creek are lacking only in data on borings. An outfit has recently been ordered, and as soon as it is received the borings will be made.

The Constabulary barracks at Ilagan are now almost completed and can be occupied. It lacks only partitions and ceilings, which are to be put in by the Constabulary soldiers unless more money is appropriated. It is proposed, moreover, to construct a concrete water tank on the ground with a capacity of 20,000 gallons; to paint the iron roofing, the woodwork, and the concrete; to install galvanized-iron gutters; and to put in a sanitary plumbing system.

LAGUNA.

Work on the San Pablo-Nagcarlang Road was begun again on December 14, but little will have been accomplished before January owing to the Christmas Holidays. Stone for the work is being shipped from the Los Baños quarry to San Pablo, a distance of 48 kilometers by rail, and thence hauled by truck and carts 7 kilometers to where the work is being done.

The resurfacing of 4.1 kilometers of the Santa Cruz end of the Santa Cruz-Magdalena Road has been completed. An Austin scarifier was used to advantage in reshaping the road surface before the new material was applied, and its use for such work instead of using spikes on roller wheels is recommended.

Being impressed with the value of good roads as constructed by the Bureau of Public Works, one of the largest land owners in Laguna, Mr. Eusebio Quintana of Santa Cruz, has arranged to have this office construct a road from the Santa Cruz-Magdalena Road to his copra-drying shed some 300 meters from the highway. It is interesting to note that this shed contains a copra-drying machine with the largest capacity of any in the Islands.

Funds having been provided by a loan of ₱12,300 to Pagsanhan, an Insular allotment of ₱18,000, and a donation by the Manila Railroad Company of ₱10,000, together with a 192-foot latticed girder span formerly used as a part of the railroad bridge at Calumpit, Bulacan, bids for the erection of the Pagsanhan Bridge were opened on October 30, and the lowest bidder, Mr. John Gordon, was awarded the contract at ₱31,500. He began work promptly and will have the greater part of the concrete in the abutments in place prior to the end of the year, while the excavation for the cylinder piers will also be well advanced by the same date.

A loan of ₱25,000 was made the province for the building of a reinforced-concrete arch bridge across the San Cristobal River on kilometer 54 of the Manila-South Road, and bids for its construction were opened on December 16. All were rejected and the work will be done by administration.

The high school at Santa Cruz has been completed, save the painting, which was not done on account of lack of funds during the present fiscal year. However, funds will be available early next year and the building will then be completed.

It is a Bureau of Education standard plan No. 20, less the four rear rooms, modified by having all the partitions made of concrete, and the partitions between the rooms on each side of the assembly hall and the hall left out so that these rooms form a part of the hall.

The Rizal Memorial School at Calamba, a building practically the same as the high school with the addition of a clock and bell tower, has been completed save the tower, which, although nearly finished, can not be completed until the receipt of imported copper tiling.

The 7-room schoolhouse at Lilio has been completed and is now occupied. The lot will be graded and leveled as funds for the work become available.

Other schoolhouse construction is under way at Biñang where an old hacienda building, purchased several years ago by the town for a schoolhouse, is being altered and repaired and made over into a fairly satisfactory school building. At San Pedro, where a plan No. 3 schoolhouse, modified by the addition of a bell tower, will be erected, part of the foundations and walls have already been completed. A domestic-science building is being constructed at San Pablo as a part of the intermediate school and a plan No. 2 building is under construction in the barrio of Santisimo Rosario. Work on both of these buildings is very well advanced and both should be completed early next year. Minor repairs, alterations, or additions have been made or are under way on quite a few other schoolhouses, and several school grounds have been improved by grading or fencing or both.

The additional market and the tiendas at San Pablo have been finished and are now in use. It is probable that further additions will be necessary in the near future.

The laboratory at the College of Agriculture, near Los Baños, has, with the exception of wiring and light fixtures, been completed and is now in use by the college. This was an administration job on which the work was under the immediate direction of Mr. A. G. Glodt and later of Mr. H. Cuzner, both of the college faculty.

No work has been done on the San Pablo waterworks, save the excavation for the intake house, on account of the necessary wait for the pipe which is being imported from the United States by the Atlantic, Gulf and Pacific Company, who have the contract to supply all the materials necessary for the system.

Advices have been received recently that the pipe will reach Manila on or about February 15, 1915, when the construction will be pushed actively until the job is completed.

Owing to the almost complete cessation of road construction within the territory served by the Los Baños quarry, its output for the quarter ending December 31, 1914, will be very small, probably not exceeding 3,200 cubic meters, while for the preceding quarter it was 6,100.5 cubic meters.

LA UNION.

At the beginning of the past rainy season a tree nursery was established on the provincial grounds at San Fernando. The tree seeds of several different varieties were planted first in seed beds where the sun could not strike them directly, and when about 10 inches high the little trees were transplanted to other beds, giving plenty of room to grow. The result is a flourishing nursery of 1,146 strong, healthy, well-rooted trees, some about 8 feet high, which, when pruned back about half length and set out along the provin-

cial roads next rainy season will doubtless have much better chance of becoming firmly established and able to withstand the succeeding long dry season than the small cuttings which each year it is the present custom to plant. The varieties of trees in the nursery are as follows:

Acacia:	
Proper	195
Small-leaf	292
Ipil	216
Tamarind	402
Mango	6
Palomaria	3
Lugo (Talisay)	32

The La Union section of the Bauang-Baguio Road (the Naguilian Trail) is now made first-class from Bauang to the provincial boundary at Ribsoan, a distance of 15.9 kilometers. From Bauang to Naguilian, 8 kilometers, the width of metalling is 4.27 meters; from Naguilian to Sili, 5.6 kilometers, was made originally 2½ meters in width, but has now been widened to 4 meters; and from Sili to the Ribsoan River, 2.3 kilometers, to the standard 4-meter width. The surfacing of the whole road is of gravel from the Naguilian or Bauang River, very hard, and laid in courses of 10, 8, and 2 centimeters, respectively, the whole bound together with pulverized shale rock, each course well sprinkled and thoroughly rolled before the succeeding course is laid.

A novel type of collapsible bridge has just been put in at Bauang, with results satisfactory so far. Owing to the shifting of the channel it would be very expensive to place a row of pile bents across the main channel each year, as this channel establishes itself in a new part of the river bed. At first it was proposed to construct movable framed bents, but these also were considered too expensive; instead, it was decided to make simple trestles, similar to carpenters' "horses" but of larger size, 1.4 meters high, to support the runways of the bridge. These trestle were built of old materials taken from replaced bridges and culverts along the Bauang-Ribsoan Road—10 by 12 inch, 10 by 10 inch, 8 by 10 inch, 8 by 8 inch Oregon pine. The only new material used was 2 by 8 inch guijo for braces, iron bolts, and U bolts. The 1-inch cable used for anchoring the trestles was part of that on hand used for anchoring the bridge, which formerly was much farther from the river bank the present bridge is located.

A much-needed improvement, the surfacing and parking of the street in front of the provincial government building, has been recently completed at a very moderate cost. This street is a continuation of the first-class road from San Fernando to the port, one-half kilometer away; but like many streets in the municipalities of these Islands, it had an offset that made it difficult to place the metalling symmetrically in the center of the street and at the same time in alignment with the port road. This difficulty was surmounted by making the new metalling 8 meters wide, and aligning one edge with the corresponding edge of the port road, which is 6 meters wide. This edge is on the side of the street next to the government building, and the offset in the opposite side is rarely noticed unless attention is called to it. The whole surface is composed of finger coral, 15 centimeters thick, well saturated and hand tamped, making a very durable and resilient pavement, as well as one pleasing to the eye.

The first-class road from Luna to Balaoan, 4.3 kilometers long, was completed November 15. This road was begun March 1, and would have been finished before the rainy season but for the fact that the work was delayed eight weeks in the best part of the working season waiting for the return of the road roller boiler which had been sent to Manila for repairs. This permitted the rainy season to catch the work unfinished, when practically no progress could be made until the 1st of October. Three hundred meters of the west end of this road was built of asphalt overflow section; this proved very unsatisfactory, however, because of the flatness of the adjacent land, and the very poor drainage, thus permitting the subgrade to become so soft that the asphalt surfacing was broken up by the passing traffic during the rainy season. It is proposed to replace this asphalt with a 300-meter concrete spillway section which probably would be much more satisfactory, having the stiffness that the asphalt section lacked.

The standard reinforced-concrete markets, at San Fernando and at Naguilian, are practically completed. The construction of these buildings has been greatly retarded, due to the delay in receiving building materials in Manila from the United States.

All exterior concrete work on the San Fernando Primary School (Bureau of Education standard plan No. 20, revised), is finished. It is regrettable that sufficient funds are not at present available with which to complete this building.

During the past year a new kind of ferry has been installed throughout the province, replacing the cumbersome, water-logged bamboo balsa formerly used. The new balsa is made in three sections of bamboos from which the outer peeling has been removed.

Two of these sections are made up of 26 bamboos each, the third of 13. These sections are bound together to form a large raft, upon which is placed a wooden platform. Swinging extensions, also of wood, suspended by wire cables from posts on the main platform, make it easy for vehicles to mount the raft. Extra sections of the balsa are kept drying on the adjacent bank of the river, to be exchanged once in two weeks for the sections in use.

LEYTE.

Traffic on the Palo-South Road has more than trebled during the last quarter. During a thirteen-hour period 34 auto trucks varying from ¼ to 5 tons capacity were observed to pass kilometer 6. The introduction of trailers with iron tires has done much to increase the cost of maintenance.

Work on the Palo School (standard No. 7) would have been completed before this except for the delay in receiving the galvanized roofing, which was not obtainable in Manila on account of the war in Europe.

The Palo market was delayed for some time for the same reason, but is now about completed. Its cost will be approximately ₱13,700, exclusive of surcharges. Its estimated cost and the lowest bid received were ₱14,263.60 and ₱15,450, respectively, exclusive of surcharges.

The abutments of the Dapdap Bridge (kilometers 25.7, Tacloban-Carigara Road) have been completed and the steel for the superstructure is now being awaited. The Atlantic, Gulf and Pacific Company have been awarded the contract to furnish same at a cost of ₱5,365.

Work has also been commenced by administration on the construction of Guinarona Bridge (kilometer 37.6) on the Palo-South Road. This is a standard 12-meter structure on wooden piles. Its estimated cost is ₱8,900. J. M. Fernandez was the lowest bidder for delivering the piles, his price being ₱5.95 per pile.

No bids having been received for the following bridges on the Maasin-Inopacan Road, the work will be done by administration: No. 34.4 over the Cang-iglang River (3 spans of 7 meters each on concrete piles), No. 33.6 over the Laboon River (2 spans of 7.5 meters each on concrete piles), No. 33.2 over the Ugayong River (3 spans of 7 meters each on concrete piles), No. 31.9 over the Punong River (4 spans of 7 meters each on concrete piles), No. 28.9 over the Dumog River (2 spans of 6 meters each), and No. 25.8 over the Taghaligue River (one 9-meter span without piles). The piles have been poured for the Cang-iglang and Laboon Bridges and driving will be commenced in a few days. All materials for the first three are on hand and those for the others have been requisitioned.

It is expected that work will also shortly commence on the Mainit Bridge (two 120-foot steel spans) at kilometer 31.4 Tacloban-Carigara Road.

The construction of the Capocan School (standard No. 2) in the barrio of Capocan, municipality of Carigara, has been started by administration. Owing to the isolated locality the estimated cost of this building is ₱5,621.

The following bids were received for the construction of the Tacloban market, tiendas, and media aguas: From Kipp & York, Cebu; S. C. Choy & Co., Manila; Tan Samco, Manila; B. Hagans, Cebu; Angko, Leyte; J. M. Fernandez, Leyte; by administration (estimate).

Bidders.	Market building, block 2.	Tiendas.		Media aguas and louvres, present building.
		Block A.	Block B.	
Kipp & York, Cebu ^a	₱11,980.00	₱5,240.00	₱5,240.00	₱2,780.00
S. C. Choy & Co., Manila ^b	13,439.00	9,395.00	9,395.00	3,850.00
Tan Samco, Manila ^c	13,916.00	7,495.00	7,495.00	3,610.00
B. Hagans, Cebu	10,584.00	5,600.00	5,600.00	3,290.00
Angko, Leyte	10,928.00	6,300.00	6,300.00	1,717.00
J. M. Fernandez, Leyte	12,325.00	4,195.00	4,195.00	2,295.00
By administration (estimate)	12,650.00	7,100.00	7,100.00	2,450.00

^a Time limit, 120 days.

^b Time limit, 200 days.

^c Time limit, 150 days.

It has been recommended that Mr. Hagans be given the contract for the market and Mr. Angko the contract for the media aguas. This is a standard market (18 by 42 meters). The present market is of concrete, but was built in 1907 before the present standard plans were drawn, and its roof is so high that the sun and rain beat in and make it very uncomfortable. To obviate this, the media aguas will be added. Louvres extend 1 meter down from the present roof and then media aguas, fastened by brackets to the columns, will extend outward 1.58 meters, thus giving ample protection from the sun and rain.

The Dulag-Burauen section (15.5 kilometers) of the Palo-South Road has been completed. Such great difficulty was experienced in rolling the river gravel which was placed on kilometers 51 to 55 that

the river gravel was abandoned, and the remainder of the road was built of hard limestone from a quarry in Dulag. This material could be compacted for one-third of the cost for the gravel, thus effecting a saving, although it cost ₱0.40 per cubic meter more than the river material. It makes a much smoother and harder road.

A complete gravity system was installed at the Dulag quarry. The stone passed from the quarry through the crushers into the bins without the use of an elevator. The clear fall available was 7.5 meters and was all that was necessary for the economic working of the plant. The cost of crushed stone in the bins was ₱1.55 per cubic meter, ₱0.33 per cubic meter of this being for dynamite and caps. The cost of loading and hauling 5 kilometers was ₱0.55 per cubic meter, being done with tramway and locomotive. On November 1 the project was placed in charge of a Filipino foreman who had been employed in the province for several years as a road-roller engineer and capataz. The progress of the work has been maintained by him at a satisfactory rate.

The work will be continued in like manner on the next section (Dulag-Abuyog), provided the weather permits. This section is a little over 24 kilometers long and crosses six rivers, each being 40 to 90 meters wide, besides many smaller streams. The first few kilometers will be built to the standard overflow section, the first place for this type of construction to be employed in Leyte. Collapsible bridges will be built over the larger streams. The estimated cost of this section is ₱261,175.77 and its average cost per kilometer is ₱10,783.69.

Some progress has been made in second-class road construction this year. Fifteen kilometers of the Maasin-South Road have been surfaced with anapog, and ferries and culverts have been built so that the section is passable at all times of the year. Fifteen kilometers more of this road will be completed shortly. Eight kilometers between Hindang and Hilongos have been surfaced with gravel and several concrete pile bridges have been completed making this section a very good light-traffic road. It is now opened to traffic at all times of the year as far north as Inopacan.

The rainy season and the heavy traffic have necessitated the resurfacing of parts of the Palo-South Road. It is expected that it will soon be brought back to its former good condition.

The Tacloban-Carigara Road is now in the best condition it has ever been, with the exception of kilometers 1 to 6. These become a little soft during a heavy rain, but harden up again immediately. The first 11 kilometers of this road carry all the traffic of both roads, but with the exception of the kilometers noted above are in good condition.

The annex to the provincial hospital has been completed at an approximate cost of ₱2,480, besides ₱100 worth of lumber donated by the Casalla sawmill.

MANILA.

The addition to the kitchen, Philippine General Hospital, has been practically completed in the sum of approximately ₱23,500. The original estimate on this bid was ₱25,000 and the lowest bid submitted when advertised, together with inspection and surcharge, amounted to approximately ₱28,000. The work has been carried out by administration and although the steel ceiling and tile floor have not yet been installed owing to nonreceipt of materials from America, yet the ₱23,500 includes liabilities taken in account for the cost of this material and its installation.

The repair work at the ice plant has proceeded continuously throughout the period under review and the first floor has been completed. The insulation of the second floor is also finished and it is anticipated that the next ninety days will see the completion of cold storage sections. The section now under reconstruction is the last section to be handled and practically puts the whole of the ice plant into a modern economical working institution.

Various improvements have been made in the girls' dormitory grounds, such as banking, making roads, paths, and landscape gardening, greatly improving the appearance of the building, particularly in the inner court.

The Anloague Building has been refitted to accommodate the Bureau of Forestry who transfer from the Oriente Building to the Anloague Building in January. The offices vacated by the Bureau of Forestry in the Oriente Building will be occupied by the Bureau of Lands and the Philippine Constabulary.

Bills of material for the northern district of the Philippine Islands have been prepared for next year's work. The bills of material for the southern district for 1915 work will be prepared during January. An appropriation of ₱60,000 made by the Legislature covers the repair work for insular light stations during the fiscal year 1915.

The repairs at Maniguin light station were completed on December 22 and the construction crew are being immediately dispatched to the Sulu Sea where they will erect two 50-foot acetylene beacons at points suitable for aiding navigation in the vicinity of the Moyune

Shoal. This latter point is where the *Bengloe* was recently wrecked and declared a total loss and is near the track of vessels sailing between Palawan, British North Borneo and Iloilo, Cebu, and Negros.

The repairs to Cape Engaño and Bolinao were also completed in the end of December and this construction crew will be sent to Apo Island and various other stations in the northern district requiring minor repairs.

The seagoing dredge has worked in the outer harbor between the piers and the entrance to the breakwater and has removed approximately 255,044 cubic meters of material during the year. She laid up on December 5 owing to insufficiency of funds to continue and this opportunity was availed of to give her the usual annual overhaul.

Dredge No. 2 has completed dredging the Pasig River and has returned to the lighthouse at the entrance to the river. The river at this point has silted up from 21 feet to 13 feet 6 inches. Insufficiency of funds demanded that the dredge be laid up on December 15.

Dredge No. 5 has completed the dredging of the Binondo Estero to the Jolo Bridge, has been given the annual overhaul, and returns to work January 4.

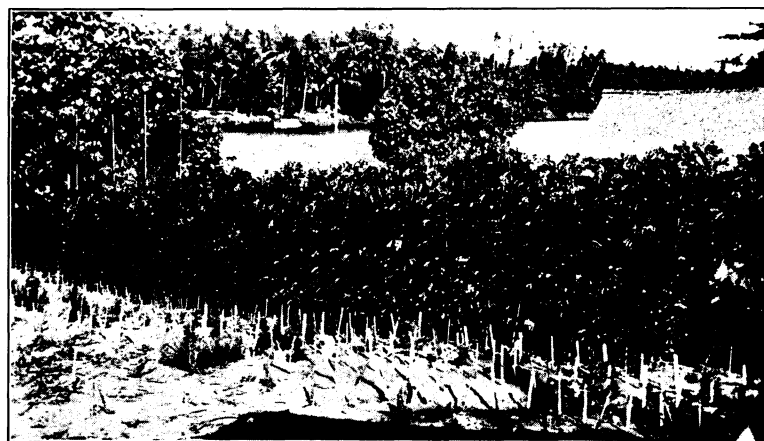
Dredge No. 6 is still in the Provisor Estero which is practically a continuation of the Balete Estero. The material excavated is being taken by the Compañía Tabacalera who have given a voluntary contribution of ₱1,000 for this purpose.

Dredge No. 7, the new hull of which is under construction, will be launched during January. The machinery will be immediately installed and the dredge placed in operation as early as possible in the upper Pasig River between the Bridge of Spain and Laguna de Bay.

The new hull for dredge No. 3 has been completed and appropriation for machinery will be requested from the Legislature in due course.

MISAMIS.

The provincial nursery is now in a flourishing condition. Most of the trees are acacias, that variety having proved best adapted to tree planting along roads.



Young plants, Misamis nursery.

The Inopacan collapsible bridge has just been completed. This is a twelve 20-foot span bridge, and was constructed for within ₱50 of the Bureau of Public Works estimate.

Kilometers 1 to 5 on the Mambajao-Mahinog Road have been reconstructed and surfaced, and on kilometer 12 a double 4.5 by 3 meter culvert has been completed.

DEPARTMENT OF MINDANAO AND SULU.

DAVAO PROVINCE.

The main work in Davao Province completed in 1914 has been the construction of the Mati Trail, a vertical or overhanging rock precipice about 2 kilometers long on the southeast point of Mindanao that has always prevented cattle or other products of the Pacific coast section of Davao Province from entering the port of Mati. This trail required a continual force of about 40 drillers for eight months in order to make it passible. Most of the work was in side-hill excavation, but part of it had to be in tunnel. All labor was brought from Cebu and paid ₱0.80 a day with quarters. They constructed sanitary quarters, organized their own mess, elected an auditing committee to check mess accounts weekly, and have lived very contentedly and happily in this isolated location,

The combined provincial and municipal building has been constructed during the year at a total cost of approximately ₱50,000. It is a 2-story reinforced-concrete structure with a galvanized-iron roof. The construction of this building, which has been promised this province for seven or eight years and for which the material for a timber structure has been collecting for three years, has created great enthusiasm on the part of the municipal officials. It is the first structure of any moment which the Government has ever given them, and the building of same has enthused them to make other civic improvements that have added to the appearance of the town very materially.

A collapsible bridge 102 meters in length is under construction over the Davao River on the Davao-South Road. This river is about 200 meters wide and is impassible at all times. All products from the south have to be unloaded on the south bank and transported across in small boats at a heavy expense. With this bridge in place traffic for wheeled vehicles will be able to proceed 20 kilometers south, there being only two swift-flowing, unbridged streams, that are passible except at flood, to be crossed.

COTABATO PROVINCE.

The construction of the Cotabato Piang-Reina Regente-Fort Pikit telephone line, having a total length of 50 kilometers, has given quick communication to the different people in the interior of Mindanao and to the new Filipino colonies established by the Government. On account of the amount of use this line was subjected to, a duplicate line was immediately put in to Piang. These lines are of the grounded-circuit type and an excellent, clear line resulted.

The Cotabato-Parang Trail has been constructed during the year so that now communication is open all the way. All the small streams have been bridged with timber structures and only the Simuay River with a 50-meter span, the Nituan River with a 50-meter span, and the Cotabato River which will need a 200-meter span remain to be bridged.

On the Cotabato-Tamontaka Road a long pile bent structure has been constructed during the year and 2 kilometers of surfaced road completed, the rolling being done with a handmade concrete roller. The first carts and rigs for Cotabato Province have been purchased this year.

LANAO PROVINCE.

Very little work has been done on roads and bridges in Lanao Province outside of maintenance, due to the fact that the revenues were needed to pay off overdrafts for previous year.

A grounded-circuit telephone line has been constructed from Dansalan to Ganasi, 38 kilometers, and from Ganasi to Lumbatan (old Camp Vicars), approximately 25 kilometers. This line connects all the Constabulary camps and also the important datto houses en route.

Some river bank protection has been constructed in Ilagan to change the course of the stream to save the municipality from being eliminated. From a natural diverting bank on the river two lines of piles, staggered, were driven and a board and bamboo entanglement made.

Investigations have been made and materials purchased to repair the approaches of the Iligan Suspension Bridge. The repairs have been provided for in the 1915 budget.

SULU PROVINCE.

A reinforced-concrete schoolhouse having 10 rooms of the No. 15 standard plan has been constructed during the year at a cost of ₱30,000. The materials for this building were purchased in 1913 and as a result a 24-gauge Apollo brand galvanized-iron roof was put on which is already in bad condition. The location is rather a good one but the grounds are limited.

One wing of the Sulu Hospital, a timber 1-story, pavillion type of structure, was completed and it has now been decided to construct the whole plan at once. This hospital was designed for Moro patients and was made very plain in appearance and located directly on the street so that the Moro patient would not be intimidated and go away after he had come in some 15 or 20 kilometers as has sometimes happened.

An extension of the T head to the Jolo Dock, some 20 meters long, has been constructed during the year. This permits merchant vessels to load or discharge all hatches at once and has given extreme satisfaction to the shipping people.

Practically 50 kilometers of grounded-circuit telephone line has been constructed using No. 9 wire on first-group poles. Jolo now has connection with the Sultan of Sulu at Maibun, Parang, Indanan, Bual, and Taglibi.

Most of the road and bridge work has been done on the Jolo-Maibun Road which has the subgrade complete. The first automobile to cross Jolo was in August and caused considerable commotion among the natives. The Sultan of Sulu has purchased two Buick cars for his personal use and P. H. Frank of Zamboanga has ordered trucks and automobiles for freight and passenger traffic over these roads.

ZAMBOANGA PROVINCE.

On roads and bridges all the money for 1915 was spent on either cancelling 1914 overdrafts or maintenance. The principal work consisted in reconstructing the Ayala and Talisayan timber bridges and in resurfacing the Zamboanga-West Coast Road in section.

Considerable time has been devoted to the beautification of Zamboanga during this year. A nursery has been started, the trees of the town carefully pruned and cared for, five concrete fountains constructed, seawalls reconstructed, flower urns erected, and many minor improvements that tend to give Zamboanga a distinctive individuality and a very pleasing appearance to the stranger who is fortunate enough to visit the town.

A grounded-circuit telephone line 40 kilometers in length has been constructed between Isabela, Lamitan, and Bohelebung on Basilan Island, thereby allowing the authorities easy control of the different settlements.

The widening of the approaches to the Zamboanga wharf are now in course of construction. The plan is to give a 10.84-meter roadway and two sidewalks 3 meters in width each. The walks are reinforced-concrete construction with a curved 60-centimeter cantilever wave breaker top. On this sidewalk there are plans for artistic concrete electric light posts, flowers urns, and seats, while midway to the pierhead there will be a square ocean pier that is needed for a waiting station for people during rains or hot sun. It will be so fitted that concerts can be given in the evenings also. The general effect will be pleasing to the eye and a boon to the public who utilize the present wharf for evening and moonlight walks.

NUEVA ECIIJA.

Grading has been completed on the Manila-North Road, north of Cabanatuan to the Pangasinan boundary. Fourteen reinforced-concrete culverts and 2 reinforced-concrete spillways have been completed. Temporary bridges have been constructed and repaired on all openings on the Manila-North Road in this province and, while not yet completed, it has been opened to traffic, and automobiles and other vehicles are using this road through the entire province. There is no section where automobiles cannot make 30 miles per hour. Acacia trees have been planted on all completed sections and they will soon be large enough to shade the entire roadway. Many of these trees are 4 meters high.

The following roads have been completed and will be declared first-class effective January 1, 1915: 9 kilometers Gapan-Pampanga Boundary Road; 8 kilometers Guimba-Pangasinan boundary section of the Manila-North Road; and 2 kilometers on the Cabanatuan-Aliaga Road.

New kilometer posts, with numbers from Manila, have been placed on all first-class roads and new road signs furnished by the Bureau of Public Works have been placed at every junction and crossing of all important roads in this province. These signs greatly assist the public and add to the utility of the roads.

Two artesian wells have been completed in the municipality of Cabanatuan and the Bureau of Public Works rigs Nos. 17 and 19 are still working in this province. It is expected to keep both of these rigs busy for the coming year.

A standard 2-room school building has been completed in the barrio of Papaya in the municipality of Peñaranda.

A standard 3-room school building has been completed in the municipality of Talavera. The work on this building was done by administration.

Work is progressing nicely on an academic building for the Central Luzon Agricultural School in Muñoz, Nueva Ecija, and the building is now 50 per cent completed.

Contract for the construction of a standard market building 18 by 42 meters has been let to D. E. Bemping & Co., and work on this building is now 30 per cent completed. It is expected to do considerable work on the construction of market buildings in this province during the coming year.

The contract for the substructure of the Talavera Bridge has been awarded to Mr. J. E. Ainsworth for the sum of ₱27,700, and work will be started on January 1, 1915.

Maintenance of first-class roads in this province is very difficult, as all roads are constructed of gravel and will not stand up under

heavy traffic during the dry season. Carretons with 2½-inch tires carry loads of 5,000 pounds, which is too much for the roads in this province, and it is believed that some law should be made which will regulate the loads carried by carretons.

Considerable work has been done in beautifying the new provincial grounds and this work will continue until the entire surroundings are planted with trees and flowers.

OCCIDENTAL NEGROS.

Work on the Hinagaran-Isabela Road was resumed in November. This is a first-class road project, its length being 17.5 kilometers. With this road completed and a bridge over the Binalbagan River, the products of the rich Isabela country will be given an outlet to the port of Hinagaran. Funds are now available for the road into Isabela and the work is being pushed with all possible speed. A bridge, estimated to cost ₱60,000, will be required for the Binalbagan River. Contributions to the amount of ₱6,000 have been made by interested parties in the two municipalities toward its construction, and an Insular loan of ₱55,000 has been requested. It is confidently hoped that this loan will be granted and that work will start during the early part of the coming year.

The Murcia Central School building was completed the first week in October, the work having been carried out by administration at a cost of approximately ₱2,000 less than the lowest bid received. The building is a No. 3, Bureau of Education standard.

The construction of the Hinagaran market building is progressing satisfactorily. It should be finished by the end of January.

The section between La Carlota and the Najalin River on the La Carlota-La Castellana Road, including all culverts, has been completed as a first-class road. This section has a length of 4.3 kilometers. The construction work beyond the river is being delayed considerably during the present grinding season on account of a scarcity of labor.

Contract has recently been awarded to Messrs. W. H. Lambert & Co. for the construction of a 21 by 42 meter market building, type B, at San Carlos. The contract price is ₱18,700.

Work on the surfacing of a 2-kilometer section of road between Valladolid and San Enrique is progressing very slowly, due to the difficulty in getting the gravel hauled. Only about one-half of this material has been delivered and rolling has not yet started.

Preliminary work was started on the Victorias-Manapla Road the latter part of December. Much difficulty has always been found in obtaining labor in this section during the sugar-cane season and it can hardly be expected that this project will be well under way before the first part of April.

Contract for the construction of three reinforced-concrete girder bridges on concrete piles on the Bacolod-North Road between Alicante and Victorias was awarded in November to Messrs. W. H. Lambert & Co. These bridges should be completed by June 30, 1915.

A timber collapsible-deck bridge, 103.7 meters long, across the Malugo River on the Bacolod-North Road is being constructed by administration.

The construction of a first-class road between Bihiquil and Kabanakan was started in October.

Contract was awarded December 15 to Mr. J. W. Ford, of Iloilo, for constructing the Prize Bridge on the Bacolod-North Road in the municipality of Saravia.

The through roads in the municipalities of Sagay and Escalante are being improved.

The athletic grounds at the Bacolod High School are being enlarged and a quarter-mile race track built. This work will be completed in December.

Contract was awarded on December 11 to Mr. Monico Puentenella for the construction of tables and ticket booth in the La Carlota market, the time of completion being ninety-five calendar days.

ORIENTAL NEGROS.

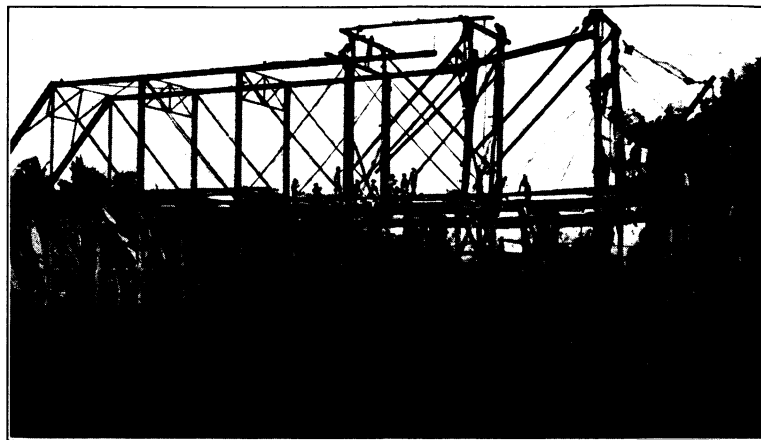
The resurfacing of kilometers 10, 11, 12, and 13 of the North Road was completed in October.

Ocoy Bridge will be completed during the first part of January. The erection of the steel was finished December 8, but owing to the small number of experienced riveters and the coming holidays, it will be impossible to complete the job this year.

Materials have just arrived for a 3 by 3 meter standard culvert to be constructed in kilometer 11 of the Dumaguete-South Road. This will be built by administration as the only bid received was considered too high. One 4 by 2.5 meter culvert, located in kilometer 3, was constructed in September by contract. Total cost ₱2,473.94, including surcharges and Insular aid.

Construction of a 7-room school at Guijulan was finished in October. Total cost, with surcharges and Insular aid, about ₱14,950. There are now five Gabaldon schools in use in the province, with one more under construction.

Work on the Bais-Tanjay Road is progressing slowly. The provincial tramway has arrived on the job and laid from the quarry to and along the road. This quarry is located on Dacó Island, separated from the mainland by a narrow channel and lies about 2.5



Ocoy Bridge, Oriental Negros.

kilometers from kilometer 45.4. A No. 4 Champion jaw crusher has been set up, but is not being used, as crushing by hand has been found cheaper.

Two road rollers are being used, one 8 and one 10 tons, but owing to the subgrade being a very sticky clay, a good deal of time is lost during the present rainy weather.

Materials have just arrived for markets at Tanjay and Guijulan. Construction will be started in January. The work at Guijulan will be done by administration. A contract for the Tanjay building 18 by 42 meters, without floor and plumbing, has been let to Mr. C. V. Powers for ₱8,625.

PAMPANGA.

Plans are being prepared for the Mexico Bridge, the last structure necessary on the San Fernando-Arayat Road.

Work will also be started on a new abutment for bridge 5.5 on the Angeles-Porac Road, the old military abutment having been undermined during the rains in September.

The Angeles-Porac Road has been resurfaced and while it is not sufficient it is hoped that funds will be available the coming year to place the road in a strictly first-class shape. The road at present is so much smoother than formerly that carromata jolting has been eliminated.

Work has been started on the San Fernando-Calumpit section of the Manila-Tarlac Road, and it is hoped that it will be passable for the coming rainy season. Two kilometers of this road are now declared first class. From Calumpit the road is second class to Pulilan and then first class to Quingua where it connects with the Manila-North Road.

Two thirds of a standard-plan, No. 10 school building is being erected at Mexico and a plan No. 6 at Macabebe. Both buildings are being constructed by administration and the plans include raising of former by 50 centimeters and the latter by 30 centimeters. All partitions are to be of concrete and the Bacolor type of open work is to be used on the front partitions.

The province has purchased, from funds appropriated for the purchase of road and bridge equipment, another rock crusher, a Champion No. 4. The Manila Railroad Company has just completed a spur to the site, but the movement of material is being delayed by a shortage of cars. Recently the company's agent delayed switching for which the province pays ₱2 per car, so that it became necessary to look for other means of locomotion. The work was let out by "paquiao" for ₱1.50 per car and was done by 3 carabaos, the steepest up grade on the spur being ¼ of 1 per cent.

Telephones connecting with every municipality in the province are being installed in all of the provincial offices.

The municipal councils of San Fernando and Mexico have accepted the proposition of the provincial board which provided that if the municipalities purchased road oil specified by the Bureau, the province

will do all labor in placing same on provincial first-class roads at such places as desired by the municipal council. One kilometer, 6 meters wide, is to be placed in San Fernando.

PANGASINAN.

The Urdaneta presidencia, a reinforced-concrete building with tile roofing, was completed on January 1, 1915, at a cost of approximately ₱34,730.

It is expected that the San Fabian market, an open-court type with galvanized-iron roof, 18 by 42 meters, will be completed by the first week in January.

The Calococ Barrio School in Binmaley, a 2-room standard building, was completed in December. Work on this building was seriously delayed by the scarcity of roofing iron in the Islands.

The Calasiao market which has been completed for some time was opened to service on January 1.

Woven-wire fences on reinforced-concrete posts have been erected around the market sites at San Carlos, Calasiao, Dagupan, and Lingayen. The division superintendent of schools is also placing this standard fence around a number of school sites.

Repair work on the Mangatarem presidencia has been started. The estimated cost of this work is ₱5,000.

Since the 1st of October 6 kilometers of subgrade have been completed on the Lingayen-Aguilar Road. It is hoped that this section may be declared first-class within a short time.

Light surfacing is being placed on the Alaminos-Balincaguin Road in the bad places so that the road will be passable for automobiles at all seasons.

RIZAL.

Three kilometers of the Manila-Antipolo Road through the town of Pasig have been reconstructed with 5 centimeters of Talim Island crushed rock. These 3 kilometers were badly worn, being in reality only in second-class condition. It was necessary to sprinkle them continuously during the last dry season in order to keep them passable at all. The alignment was straightened in places, the shoulders rebuilt, and the whole placed in first-class condition with very reasonable expenditure.

The reconstruction of the first kilometer of the Manila-Novaliches Road has been completed, and first-class construction carried on up to the end of kilometer 10. The material used was Talim Island crushed rock with gravel and sand binder from a nearby stream. It is the intention to continue this construction on the north road line of the province, making an alternate route for the Manila-North Road, connecting thereto at Norzagaray in Bulacan. This will open up an almost virgin country suitable for sugar cane and highland rice. Two small culverts remain to be constructed on the first-class section as soon as materials can be secured.

The resurfacing of the Manila-South Road has been completed from the end of the asphalt section at the Polo Club to the provincial boundary line at Zapote Bridge. Shoulders were built up and the surfacing on kilometers 6, 7, and 8 was widened to 5 meters. About 800 cubic meters of crushed rock were used in this work. Two small culverts are still to be built at Las Piñas as soon as materials can be obtained.

About a kilometer of the asphalt section of the Manila-South Road has been patched up by the use of all the material available in the local market. Other material for completing this section has been on requisition in the States for several months, and the whole asphalt section will be placed again in first-class condition as soon as it arrives.

The municipality of Pasay has appropriated ₱2,000 to be used in surfacing 2 kilometers of municipal streets. Two inches of crushed rock is being placed to a 3-meter width. The municipality contemplates appropriating ₱7,000 or ₱8,000 more during the coming year for surfacing other streets in the same manner. Early in the present year 1½ kilometers of the principal streets of the town were surfaced, and the experiment has proved so successful that the council are bending all their efforts to surface all streets in a similar way.

Plans and estimates have been drawn up for two timber trestle bridges on wooden piles one on the Tagig-Alabang Road along the west shore of Lake Laguna, and the other across the Pateros River near Fort McKinley. These plans are now before the Secretary of Commerce and Police for his approval of the erection of temporary structures. The bridges will probably be advertised early in the coming year, and the construction completed without delay.

Mr. Tan Samco of Manila has completed his contract for the construction of a standard market 24 by 42.8 meters at Pasay. His contract price was ₱17,500, but on account of substitution in the brand of galvanized iron used, this was reduced to ₱17,116.18. Mr Isidoro

Reich of Manila has completed his contract for the Pasay tiendas adjoining the market, for ₱6,650. Substitution in brand of galvanized iron reduced the contract price to ₱6,562.26.

The municipal council of Antipolo has authorized the construction by administration of 10 kioskos to be located on the town plaza in front of the church. The estimated cost of ₱14,232. Subcontracts have been let for the construction of the kioskos, the Government supplying all the materials. It is thought that ₱3,000 will thus be saved.

The Rizal Provincial High School, a modified plan No. 20, has been advertised, and bids will be opened on December 29. It is planned to complete this building in time for the opening of school in June. Bearing power tests on the soil are now being carried on, and will probably show a bearing power of 5,000 to 6,000 pounds per square foot.

The boundary survey and location of monuments between the municipalities of Cardona and Binangonan have been completed and final report on same is being prepared for the Executive Secretary.

SAMAR.

Work on the construction of about 7 kilometers of first-class road from Calbayog to Sabang, the commencement of the Calbayog-North Road, has been resumed since the change of the monsoon last October, where it was practically left off at the opening of the northeast monsoon season last May. The road roller was kept busy most of that interval rolling the streets of Calbayog with one heavy course of coral rock. A part of this rock was gotten out by prison labor. It is expected that the Calbayog-Sabang Road will be finished before Christmas.

The construction of a trail from Borongan south to Llorente has been in progress since last May. This is primarily a relief project. At the end of November, 14.3 kilometers had been completed.

On the Carangian-Laoang Road automobile traffic has been on the increase. There are now 4 machines doing business. However, the heaviest rains are due in December, and since most of this road is not metalled, it is likely that wheeled traffic will not do much business until the weather clears up in February next.

The bulk of the materials intended to be used in the construction of a No. 7 schoolhouse at Oras, and a No. 3 building at Dolores, on East Samar, were successfully delivered in spite of the fact that the northeast monsoon was blowing and created more or less swell. Lighters proved to be hard to secure on reasonable terms: some owners, mostly Chinos, asked ₱40 per day; but three were finally secured for ₱10 per day. No agreement has been arrived at in the case of a fourth, the owner of which is endeavoring to hold up the province for ₱30 per day. This is one of the many difficulties that attend the construction of public works in Samar chargeable to poor communication.

The provincial board is desirous of erecting a capitol building during the present administration and everything looks favorable for its accomplishment. Funds are in sight, a tract of land, beautifully situated, has been surveyed in accordance with regulations, and the only thing lacking for the drawing up of the plans is the approval of this site by the Executive Secretary.

SORSOGON.

During the last three months in the Province of Sorsogon, as a whole, there have been very heavy rains. These rains have greatly damaged the surfacing all over the province, especially on kilometer 18, on the Bulan-Irosin Road; on the other hand, in Masbate, during the same time, there has not been one single shower of rain.

The construction of the Sorsogon-South Road has been advanced so that the surfacing is completed up to the end of kilometer 20. The grading has been completed up to kilometer 23 and within three months will be finished to kilometer 35.5 in the barrio of Buhang. It is expected that during the first six months of the coming year the road will be opened up for traffic as far as Bulusan, kilometer 42.5.

During the last three months two artesian wells have been driven in the town of Bulan, both free flowing, one 10 gallons and the other 5 gallons per minute. The well rig is now working in Irocin.

The Irocin Central School, including one concrete outhouse, has been completed at a cost of ₱5,794.44. A White auto truck, rented from the Bureau by the province, proved a success in solving the question of cheap transportation of materials and supplies for the school building, and was a stimulating factor in the starting of private commercial motor transportation.

Construction has been started on a standard No. 3 building for the San Fernando Central School. This will probably be completed about the end of January.

SURIGAO.

The heavy rains during the first part of November necessitated the abandoning of all road construction, especially the Placer-Mainit Road. Seven kilometers of this road have been declared first class, although the road is open for traffic to kilometer 16; this was made possible by surfacing several short stretches of exceptionally muddy places which, while hard enough for ordinary traffic during the dry season of the year, would, however, be impassible during the wet season. A number of American ingot iron culverts were placed in the mountainous section of this road.

The loan of ₱40,000 Insular fund asked for the construction of the Surigao-Sison Road was reduced to ₱30,000 and work was commenced immediately, though owing to the heavy rains during the latter part of November and fore part of December, only such places as were high enough for rapid drainage could be worked.

TARLAC.

The survey of the site of the proposed Camiling Bridge on the Camiling-Bayambang Road is now completed. A request for the design of this bridge will be forwarded to the Manila office as soon as the boring now going on to investigate the foundation is completed. This bridge when constructed will be the most important one in the province, first, because of its size, and, second, because it is inter-provincial, Camiling being in Tarlac and Bayambang in Pangasinan.

The survey of the Tarlac-Camiling Road is nearing completion.

The Matatalaib Barrio School is now finished. This is a plan No. 3 of the Bureau of Education with all partitions concrete except one. The actual cost of the work including surcharges amounted to ₱6,584.22.

A No. 3 schoolhouse in the barrio of Bani, municipality of Paniqui, is under construction.

The work on the Gerona market is progressing very rapidly at this time and if it is not delayed on account of lack of galvanized-iron roofing, will probably be completed during the month of January, 1915. This work is being done by administration.

The work on the Camiling presidencia is progressing quite rapidly. On account of the scarcity of galvanized-iron roofing at the present time, it was decided to use tile roofing on this building.

The Tarlac-La Páz Road construction is going on, although slowly through lack of sufficient funds. The entire road is now staked out and effort is being made to clear the whole right of way and put same in condition for cart traffic, thus facilitating the hauling of palay after the harvest season.

Owing to the scarcity of rain, the rice planters here claim to have lost 50 per cent of their crop. It is feared that the laboring people will suffer greatly during this dry season. A large fund for road work is the only hope of the laborers of Tarlac until the next crop.

TAYABAS.

The main building, Lucban market, 18 by 34 meters, has been completed by administration at a cost of ₱12,030.30. Funds are available for the construction of one block of tiendas.

Construction of the main building for the Sariaya market, 12 by 34.5 meters, has been completed by administration. Cost, ₱9,823.34. One block of tiendas will be constructed and, possibly, a matadero.

Lucena market building construction has been seriously delayed through lack of roofing iron, the supply of 22-gauge iron in Manila being exhausted.

Construction of Mauban market building is under way by administration. Progress is fair, but labor conditions have operated against rapid construction.

The municipality of Atimonan has funds available for a small market building, construction of which by administration is being inaugurated.

Work on the Atimonan-Gumaca bridges, by contract, has been delayed owing to difficulty in obtaining suitable sand and gravel.

Good progress has been made on the construction by administration of a plan No. 3 school building at Alabat.

Funds are available for the construction of a modern school building at Infanta. It is intended to construct a plan No. 7, Bureau of Education, schoolhouse.

Field work in connection with the investigation of a proposed waterworks system for Lucena has been completed, and the office work is being pushed to permit an early consideration of the financial questions involved. The feasibility of this project is so apparent that all concerned are using their utmost endeavors to secure funds for construction.

In spite of the fact that the price of coprax has fallen to approximately two-thirds of former quotations, the crop is so large this year that a normal total money return will be secured, according to local dealers.

Work on the extension of the Manila Railroad southern lines has been much curtailed, only a small force being now employed. The company now operates regular trains as far south as Maliboy, though track is laid beyond Laguimanoc to a point opposite Unisan. On the Pacific end the rock cut at approximately kilometer 49, Atimonan-Gumaca Road, where the railroad parallels the provincial highway, is now being taken out. When completed, the railroad will open up wide stretches of territory which now have poor transportation facilities.

ZAMBALES.

During the quarter the following bridges were completed: Sacatihan bridge, one 8-meter span, slab and girder; Dalayap bridge No. 16.4, three 6-meter slab and girder spans, on concrete piles; Amungan culvert, 3.5 by 2.5 meters, double span.

With these structures, there have been completed in all during the year 10 bridges and culverts, having a total span of 99 meters.

Failure was encountered at Dalayap bridge No. 16.5 in blasting a 1-meter layer of hard coral under a 6-meter head of water, using a 7-meter fuse. Finally, a successful blast was obtained by using fuses only 1 meter long. The process is as follows: The hole is made with the ordinary churn bit, using 2½-inch casing. Having penetrated the full thickness of the layer, the casing is lifted just above the top surface of the same. The required charge, with two sets of caps and fuses cut 1 meter long, is tied at the end of a piece of bamboo about 7 meters long. It is then introduced into the pipe casing. Immediately after lighting the fuses the charge is lowered and pushed home carefully into the hole. Before the charge explodes the casing is lifted to safety. In this way no charge failed thereafter.

A new road is to be surveyed between the towns of Iba and Masinloc. The present road follows the coast line and passes through the town of Palawig. There are many deep tidal streams, and it is believed that a new route can be found doing away with these streams and saving about 5 kilometers in distance between the two towns. The town of Palawig can be served with a branch road.

The deep-well rig is now working in Botolan.

GENERAL ITEMS.**ROAD EQUITIES.**

It is becoming apparent to the highway authorities of the world that the development of highway traffic is producing conditions more and more inequitable with the passage of the years. The traffic is becoming more complex because the vehicles in use are becoming more varied in potentialities and possibilities. Formerly the speed of a vehicle was conditional upon that of a horse or two; the size of vehicle and the load carried was limited to the same 1 or 2 horsepower. At the present time, generally, there is no limit to the various possibilities in speed, weight, width, length, and load of the vehicles. Formerly, the power drawing pleasure vehicle was limited to 1 or 2 horsepower; to-day the power of a pleasure vehicle may be 60 horsepower. Formerly, the power drawing a loaded vehicle varied from 1 to 6 horsepower—the latter being very rare; to-day the power drawing a loaded vehicle may be 70 horsepower. Formerly, the power was animal; to-day, the power is either animal or mechanical. Formerly, all the traffic was moved by animal power; to-day, in many places mechanically driven vehicles are supplementing, almost completely, animal-drawn vehicles. Formerly, the variations in the power moving vehicles were so small that a general tax of an equal amount was practically equitable; to-day such a tax

is greatly inequitable, and consequently justice in taxation demands a readjustment.

In the Philippine Islands it is necessary that a road be constructed stronger to carry a heavily loaded carter than to carry a heavily loaded carreta. It is necessary that a road be built stronger to carry a heavily loaded motor truck than to carry a heavily loaded carromata. It is necessary to expend extra sums per year to maintain the roads if the extra-heavy vehicles are permitted to use the roads. It is necessary to incur additional expenditures for maintenance if vehicles of high speed pass over them. Therefore, to obtain equitableness it is necessary that the extra cost of constructing stronger roads and maintaining them be placed upon the owners of the vehicles that cause the extra cost.

It is pertinent to the question to quote from a recent address of State Highway Commissioner John N. Carlisle of New York. He stated:

Last year we had about 1,000 more miles of roads in this State than the year before, and about \$1,500,000 less to maintain them. The license law is inequitable. Suppose we build a good road, and some fellow secures permission from the public service commission to operate a bus line. His automobiles are going over the road all the time, fair weather and foul, and will tear it up quicker than 1,000 farmers or autoists. Yet he pays \$5 per year for each of his commercial vehicles. If he were running a trolley line he would have to pay a special franchise tax, which would amount in some cases to about \$100,000 per year. Yet he is using our roads as a trolley line. The man who owns a Ford, say, pays about enough as it is. When you get above that, you ought to pay *pro rata*. We have got to have a general vehicle tax. Near Poughkeepsie, we built a road which cost \$12,000 per mile, and as soon as it was opened to traffic, 20 heavy teams commenced to draw stone over it from a nearby quarry which never could have been opened and operated were it not for the building of this new and improved road. These 20 teams tore that road to pieces in a short time. Yet the owners of that quarry paid nothing for the maintenance of the road they were so rapidly destroying. They should be made to pay. I believe in a fair tax imposed as it ought to be imposed—not an excessive one.

At the last International Road Congress which was held in London in June, 1913, several reports upon the extraordinary effect of certain classes of vehicles upon the roads were made. The German report estimated that light motor vehicles did not cause abnormal wear unless the speed exceeded 15 miles an hour, but that the actual speed was often over 25 miles an hour and that at such speed they abstracted the fine binding material, injured the road through nonskid devices, and loosened the top layer by skidding at sharp curves. It stated that heavy motor vehicles, which often run as high as 18 miles an hour, grind away the road surface, loosen the stones from hollows through pounding caused by swaying, crush the surface stones, and produce dust. It declared that ordinary macadam roads are not suitable for such traffic.

The British reports declared that the weight allowed on the axles of heavy motor vehicles in England is probably 40 per cent too high. Small diameters of wheels were also stated to be a source of damage. A greater width of wheel than under present regulations was said to be needed.

The reporter from Holland maintained that the load on the wheel should be in direct proportion to the width of the tire and the square root of the diameter of the wheel; and that it should be in direct proportion to the square of the thickness of the road crust.

The State of New York limits the weight to be carried on any one axle to 8 tons.

Porto Rico laws provide that for vehicles having four wheels, excepting motor driven, the following regulations shall obtain: A vehicle carrying a load of 1,000 to 2,000 pounds the tires shall be not less than 2 inches in width; carrying a load of 2,000 to 4,000 pounds the tires shall be not less than 3 inches in width; and vehicles having a load of 4,000 pounds and up the width of tire shall not be less than 4 inches. For vehicles of two wheels and for loads exceeding 1,200 pounds the width of tire must be 3½ inches, provided, that no vehicles of two wheels shall be allowed to carry a load exceeding

3,000 pounds. For heavy motor cars the total allowable weight of a laden heavy motor car shall in no case exceed 20 tons. Heavy motor cars traveling over the insular roads shall have the proportion between tire and weight of wagon loaded as determined by the following: The width of the tire of both front and rear wheels of a heavy motor car shall be such that the pressure per inch of diameter and per inch of width of tire shall be not greater than 16 pounds.

An English authority upon roads has proposed, recently, the following queries:

First, are the few traders to be allowed to make a saving in railway charges at an expense to the general body of taxpayers greatly in excess of the saving effected?

Second, is it fair to the great majority of those who use vehicles not carrying excessive weights to have the roads cut up and destroyed and be made to contribute to the heavy damage caused by the excessive weights of individual users?

Third, is it to be regarded as the duty of road authorities to incur whatever expenditure may be necessary to maintain or reconstruct the road in a suitable way for any vehicle which under the existing laws can use our highways?

Higher efficiency is a usual concomitant of heavier loads. The heavily loaded carter, the motor truck, and the motor bus have become economic necessities in modern life and the State cannot and should not discourage their use, but the tendency is to increase the carrying capacity of these vehicles and the results will be, if proper regulations are not adopted, that the improved highways will be serving the purpose of a railroad roadbed, and without some check it is certain that no form of highway construction will stand.

Those industries situated beside the highways and which require an extra-constructed or extra-maintained highway should be required to meet the extra expenditures through taxation. The causation of extra wear is extra taxed in France. Formerly the water service in municipalities was paid for through a general tax which was not based upon the consumption. To-day, those municipalities that do not require payment based upon the meter are considered as unmodern. With the meter, the water user pays precisely for what he uses. With proper regulations, the road user will pay precisely for his use of the road.

FINANCIAL.

APPROPRIATIONS AND ALLOTMENTS.

All funds appropriated for roads and bridges for the Insular fiscal year beginning January 1, 1914, have been allotted and deposited.

LOANS FOR ROADS, BRIDGES, SCHOOLS, MUNICIPAL AND PROVINCIAL BUILDINGS, ETC., FROM OCTOBER 1, 1914, TO DECEMBER 31, 1914.

Province and project.	Act Nos.			Total.
	1728.	1729.	2083.	
Albay: Catanduanes trails	P5,000			P5,000
Ambos Camarines: Daet-Mercedes Road	50,000			50,000
Batangas:				
Santo Tomas market		P10,000		10,000
Taal waterworks systems	6,000	9,000		15,000
Capiz: Capiz central school building		4,000		4,000
Isabela:				
Bagabac-Isabela and Ilagan-North roads	40,000			40,000
Rugao and Buyong bridges			P50,000	50,000
Laguna: San Cristobal Bridge		25,000		25,000
Nueva Ecija: Malimba, Taboating, Baliuag, and Talavera bridges			180,000	180,000
Occidental Negros: Escalante primary central school building		5,000		5,000
Sorsogon: Bulan-Irosin, Sorsogon-Albay, and Sorsogon-South bridges, and the Sorsogon-South Road		20,000	80,000	100,000
Surigao: Surigao-Sisson Road	30,000			30,000
Tayabas:				
Gumaca market		12,000		12,000
Tayabas market		18,000		18,000
Calauag market		8,000		8,000
Total	131,000	111,000	310,000	552,000

SELECTED.

A RAINY DAY COMPLAINT.

By WAYNE G. LEE, Columbus, Ohio.

The rain comes down and the road is mud;
 It pours and pours and pours.
 My old heart beats with a sickening thud,
 While it pours and pours and pours.
 I sit at my window, the scene is sad,
 A road that is muddy is a road that is bad.

The heavens are open, the water pours out;
 For it rains and rains and rains;
 The cows in the barnyard are all in a pout,
 While it rains and rains and rains.
 A lake in the roadbed has grown apace
 From rains that have fallen through Almighty's grace.

There's a flash of lightning, the thunder's roll
 Make it rain and rain and rain;
 The old, rough road is now a mudhole
 From the rain, the rain, the rain;
 My careworn head is racked with pain
 Because of the road, the mud, and the rain.

The clouds in the sky are breaking away
 From the rain, the rain, the rain;
 My mind is pondering a brighter day
 Void of rain, the rain, the rain.
 There is hope in my heart as the rainbow gleams
 For a better road if I spend all my means.

The rain is gone and the sun comes down;
 It shines and shines and shines;
 And the old mud road has now a crown
 That shines and shines and shines;
 For scientific efficiency and proper care
 Have rid my life from all despair.

The road is smooth—no ruts are there
 As I ride and ride and ride;
 No rain can muddy the highway fair
 That I ride and ride and ride;
 For the metal is stone—the bridges are strong—
 And I sing to myself as I travel along.

Now the rain pours down, no water is there,
 On the road, the road, the road;
 I ride in the storm with my old mare,
 On the road, the road, the road;
 It can rain all week—I'm going to town—
 Ohio's made good, let the rain come down.

—(*Better Roads and Streets.*)

APPENDIX A.

CIRCULAR LETTERS ISSUED BY THE CONSTRUCTING DIVISION FROM OCTOBER 1, 1914, TO DECEMBER 31, 1914.

MANILA, September 25, 1914.

Constructing Division Circular No. 149.

SIR: I have to invite your attention to the following excerpt from a communication of the Director of Education:

"SIR: I have the honor to transmit for the information of district engineers the following list of supplies for schoolhouse construction still remaining in stock at the Bureau of Supply:

	Pieces.
F-2937-5. Rods, tension, 1 inch by 7 feet 11 inches.....	590
2938-5. Rods, tension, $\frac{3}{4}$ inch by 4 feet 5 inches.....	1,198
2939-5. Rods, tension, $\frac{3}{4}$ inch by 4 feet.....	601
2943-2. Stirrups, $\frac{1}{2}$ by 3 by 12 inches, $\frac{3}{4}$ inch hole....	145
2935-3. Straps, $\frac{1}{4}$ by 1 $\frac{1}{4}$ by 6 inches.....	64
2992-4. Angles, $\frac{1}{2}$ by 2 $\frac{1}{2}$ by 24 inches.....	186
2991-4. Angles, A to D.....	194
2941-3. Straps, $\frac{1}{4}$ by 1 $\frac{1}{4}$ by 6 inches.....	426
2931-2. Anchors, jamb, $\frac{1}{4}$ by 1 $\frac{1}{4}$ by 6 inches.....	993
2934-3. Angles, A to C.....	43
2936-3. Roof plates.....	422

"This office has been advised by the Purchasing Agent to the effect that the above-listed items are moving very slowly. These supplies have been ordered in accordance with the estimates furnished by this office. It seems, however, that district engineers have lately been ordering the ironwork for schoolhouse construction from the provincial trade schools. It is therefore requested that district engineers be directed to requisition such supplies from the Bureau of Supply until this stock is exhausted."

In submitting requisition for schoolhouse materials you are directed to order from the Bureau of Supply such quantities of the supplies listed above as may be needed for the project and no orders for these items will be placed except with the Bureau of Supply until the stock is exhausted.

For the Director:

E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,
HIGHWAY ENGINEER,
SENIOR SUPERVISING ENGINEERS,
DEPARTMENT ENGINEER, Mindanao and Sulu, and
CITY ENGINEER, Baguio.

MANILA, September 26, 1914.

Constructing Division Circular No. 150.

SIR: I have to invite your attention to the attached copy of "Instructions for planting nurseries" issued by the Bureau of Forestry. The information contained in these instructions is clear, complete, and helpful, and should prove of much value in carrying out the roadside tree-planting program in your district. Additional copies of these instructions can be furnished if desired.

For the Director:

E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,
HIGHWAY ENGINEER,
SENIOR SUPERVISING ENGINEERS,
DEPARTMENT ENGINEER, Mindanao and Sulu, and
CITY ENGINEER, Baguio.

BUREAU OF FORESTRY,
MANILA, June 8, 1914.

Planting nurseries.

INSTRUCTIONS FOR PLANTING.

General.—The critical period in the life of a young plant is in the early seedling stages. Survival depends on the ability of the seeds to germinate and penetrate the ground and in the hardness and rate of growth during the first few years. Seed germination is mainly dependent on the moisture condition of the soil while the subsequent development of the plant is badly hindered by the crowding of grass and other weeds. Nursery-grown plants escape both of these risks which are placed under the control of the nurseryman.

A nursery, then, is an area where trees for future planting are grown. The site is chosen with a view to obtaining the best combination of shelter, soil, and moisture conditions. A newly cleaned area with low trees protecting it from strong wind and intensive insolation is a good site for a nursery, provided it has good drainage, is near to water, and has a soil depth of at least 30 centimeters. A sandy loam is always to be preferred as it is easy to work, takes in water readily, and does not bake in the dry season. The soil is prepared at least two weeks in advance of sowing by removing the vegetation above the place to be used as a seed bed and then grubbing out all the roots and raking the surface until it is thoroughly clean. The ground is then loosened with a plough or mattock, breaking up the clods of earth to a depth of 10 centimeters.

Seed beds are located in the open on the best portion of the nursery as regards wind protection, slope, and soil. The usual size for seed beds is 1 meter in width and up to 5 meters in length. Transplant beds can be made 1 $\frac{1}{2}$ meters wide, using hoes for weeding. The paths between the beds are about 20 centimeters wide, but the main paths are fully 1 meter wide. In the case of transplant beds, natural shade should be taken advantage of by preserving the smaller trees upon the area, but if they occur in close groups, their tops should be trimmed in order to allow sunlight to go through. Transplant beds do not require as much preparation as seed beds—shade and freedom from weeds being the essential requisites.

NURSERY WORK.

Sowing.—If the seeds are sown too early in the nursery, the plants grow to be of a size expensive to handle before the coming of the rain; but if the plants are not ready for planting out in August, a large number may be lost in the following hot season due to failure in getting well established before this unfavorable period.

Watering.—Newly sown beds must be kept moderately and uniformly moist. Too much water may hinder germination, may cause the seeds to rot, and the seedlings to be unhealthy. After germination, however, the beds should be sprinkled liberally at least once a day, and in very dry weather twice a day. The best time to water is after 4 o'clock in the afternoon, and if it is possible to do so a second time it should be done early in the day between 6 and 9 o'clock. Watering the beds in the hottest portions of the day causes the plants to wilt while very little good is done, as the water evaporates instead of sinking into the deeper layers of the soil.

Shading.—If the beds are watered at least once a day and kept mulched with grass they may be left in full sunshine; but if the sowing is done during the dry season it is advisable to choose a shady portion of the nursery as this will prevent extremes of heat and dryness, which are unfavorable for good germination. If such an arrangement can not be had, artificial shading must be resorted to, such as scattering brush over the beds or building a frame over them on which palm leaves or brush are spread. Shading is only used on very hot days or during the hottest hours and not fixed permanently. Shading is very necessary for the transplant beds, where small trees, 3 to 5 meters in height, are usually left. Then, as the plants appear to recover from being moved, the foliage of the shade trees is gradually reduced until the seedlings enjoy free light during the last three or four weeks before planting out permanently.

Care.—The seed beds are continuously watched for signs of germination, so as to remove the cover of mulch at once. Weeding is done by hand before the seeds have germinated, but light hoes can be used if handled carefully. If the seedlings appear very crowded, the weaker ones may be pulled out or else the larger plants transplanted to give the others more growing space. Seed beds require the greatest amount of care during the germination period and transplant beds during the first week following transplanting.

Sometimes, due to too early sowing, the plants in the nursery become too large to transplant at a reasonable cost. In such a case the practice is to dig up the plants and plant them in a shady place side by side in a narrow ditch where they are kept until the arrival of a favorable time for planting. The development of the plants is thus checked without imperiling their existence.

Transplanting.—Transplanting has in view the production of larger plants, with strong vitality and with fibrous roots not over 15 centimeters long. With proper care, the plants are induced to produce such roots in the nursery, are made to grow larger, and finally they are hardened to full sunlight in dry soil such as will be encountered in the planting area. The process, however, damages the young roots

of the plants temporarily, as the work is done rapidly in order to cheapen the labor cost, the success depending on the care and shade them during the first few days immediately following the operation. Transplanting is done often to relieve the crowding in the seed bed, and also in the case of species producing strong, deep tap roots which make their moving difficult of success.

Bare-root method of transplanting.—Cloudy or rainy days are chosen for this operation, but it can be done on less favorable days provided the wind does not blow strongly. The seed beds are wet thoroughly a few hours before commencing to dig the plants, which prevents breaking many of the roots. A mud puddle is previously prepared by mixing clay soil and water in a vessel or in a hole in the ground for use in protecting the roots against the sun and wind. Green leaves or grass or even wet gunny sacks are used in covering plants after digging. The plants are carried in shallow boxes. This is preferable to wrapping them in wet sacks or grass. The digging and the planting should be so balanced that the plants remain out of the ground the shortest possible time. Digging is begun at one end of the bed where a ditch is made as deep as the roots; then by inserting a spade or spading fork between the first and second row of plants a large lump of soil containing several of them can be raised. Break up the soil before picking up each of the plants, but do not exert any pull if the roots are not loosened sufficiently. Do not try to shake off every particle of earth adhering to the roots. Avoid barking or mangling any portion of the roots or of the stem; if any are thus damaged they should be discarded. As soon as four or five plants are picked up the roots should be immersed at once in the mud puddle, placed in the box and protected with a cover of leaves or grass.

Small plants up to 10 centimeters in height can be planted with a small dibble, or by merely making a hole in the ground with a finger, or by making shallow trenches with the corner of the hoe. Larger plants necessitate the use of a planting trowel or a mattock. Avoid handling the plants any more than is necessary. Make the holes larger and deeper than actually needed, to prevent bending the roots or any delay putting the plants in the soil. It is essential that all the roots be placed in firm contact with moist soil and that no cavities are left in the stirred soil by the presence of clods, sticks, or leaves. The soil is firmed by a mere pressure of the hand if the soil is wet and heavy, but if somewhat dry and loose it requires tamping with a blunt stick. Heavy soil should not be tamped too much, as this causes hard packing and cracking when beginning to dry. One good method of planting is as follows: Hold the plant in the left hand, lowering it in the hole so that the junction of the root and stem will be 1 or 2 centimeters above the ground. Arrange the roots so that none are twisted, bent, or struck together with mud. The soil dug out of the hole is then placed back with the right hand, taking one handful at a time to crumble the clods as they pass through the fingers. Some experience is necessary to be able to hold the plants above the hole in such a fashion that in tamping the soil the plant is not buried too deep.

Ball transplanting method.—This method requires more care than the preceding one, is more expensive, but highly successful. It consists in lifting the plant together with a mass of undisturbed earth inclosing most of the roots. Its success depends on having the right amount of moisture, and the soil, which prevents the lump of earth from falling to pieces, and in the care with which it is handled. The operation is slow and expensive, but it is practicable for use on a small scale. To preserve the balls of earth the plants are placed in a wooden tray for carrying them about, and covered until replanted.

Special methods.—Species strongly taprooted can be transplanted in shallow boxes containing a layer of soil about 10 centimeters deep, for the purpose of counteracting this strong tendency. Plants difficult to move out of the nursery are sometimes sown or else transplanted into bamboo joints or other cheap receptacles. The joints of bamboo used have an inside diameter of 6 to 10 centimeters and are 20 to 40 centimeters long. The joint which is used as the bottom of the pot should be 6 to 8 centimeters above the ground. The plants soon send down roots which penetrate the ground beneath the pots but this can be prevented by standing them on boards or on stones. If the bamboo pots are not watched continuously the white ants soon destroy their bottoms and even eat up the softer portions of the bamboo. Transplanting into bamboo joints assures the life of the plant both in the nursery and in being planted out and should be used in connection with valuable species or in trying conditions when the expense of one extra centavo per plant almost means assured success.

PLANTING OUT.

Fields preparation.—In parang areas this consists usually in burning the grass, thinning the parang trees, and cutting out the climbing bamboo and vines. Due attention should be given to the building of fire lines to restrict the burning to the planting area alone. This is done by clearing a strip 4 to 6 meters wide of all inflammable material, encircling the area to be burned and stationing men holding living branches of trees with which to beat out any fire crossing the strip. Firing should begin at the leeward edge of the tract and

then it can be set all around the edges. This is best done early in the day or nightfall when the air is fairly still and the fire is therefor easy of control.

Staking.—When using small plants it is preferable to have the planting spots marked previously with stakes, which are afterward driven near the plants to help in relocating them. For this purpose there should be a base line from which parallel lines may be run at right angles to it to guide the planter. The stakes may be set by eye between these parallel lines.

Planting.—The best time to plant is when the rainy season is well advanced, the ground soaked thoroughly, and the weather promises rain or cloudiness for two or three succeeding days. Strong wind, even on cloudy days, is very harmful in planting operations. The most common method of planting is the bare-root method. The long roots are trimmed back as soon as dug out and the top reduced in proportion. Immerse all the roots in liquid mud and protect as described in the method for transplanting. While not being used, the plants should be covered with a thick pile of grass and kept in the shade as much as possible. Very long or damaged roots are cleanly cut with sharp knives or pruning shears and the tops are reduced to balance the loss of root surface. Only a few species can be planted out with little or no trimming of the foliage. The plants are carried in boxes or pails, but can be merely wrapped with wet gunny sacks. The planting holes are usually 15 centimeters in diameter and 15 centimeters deep, dug with mattock or heavy hoes. Planters should be watched continually as their carelessness in handling the plants often results in a high per cent of mortality. All the various processes of planting are done rapidly, as the longer the plants remain out of the ground the more is their chance of surviving reduced.

MANILA, September 26, 1914.

Constructing Division Circular No. 151.

SIR: Information is desired on the condition of each and every artesian well within your district which has been rated by this Bureau as a successful well. The information desired is:

1. Location of well.
2. Number of well.
3. Whether flowing or pumping.
4. The extent to which water is being used.
5. If not flowing, the kind of pump installed, if any.
6. Whether the pump is effective and pumping full capacity.
7. Whether the pump is in good repair, stating in detail to what extent parts have been worn and in what way the pump is out of repair.
8. Is the municipality safeguarding the well and its surroundings against contamination.
9. Is the municipality safeguarding the pump against unnecessary use, thefts of small parts, etc.
10. What is your recommendation for keeping pumps in serviceable condition at all times both as to supplying spare parts and preventing excessive wear and breakage.

It is important to have this information within thirty days in order that the matter may be submitted to the Philippine Legislature with a statement of all the facts as they appear at present. This should, therefore, receive your immediate attention. Where a personal inspection is not possible, other responsible employees of the district force may be employed to secure the desired data.

For the Director:

E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,
HIGHWAY ENGINEER,
SENIOR SUPERVISING ENGINEERS,
DEPARTMENT ENGINEER, Mindanao and Sulu, and
CITY ENGINEER, Baguio.

MANILA, October 1, 1914.

Constructing Division Circular No. 152.

SIR: I have to invite your attention to the inclosed copy of a letter sent by the Board of Public Utility Commissioners to the railroad companies in the Philippine Islands relative to the construction and maintenance of highway crossings.

You are directed to carefully familiarize yourself with the contents and instructions of this letter and bring same to the attention of all your employees concerned. You will coöperate with the railroad companies in every necessary and proper way in all matters pertaining to highway crossings, and you will promptly report to the Bureau every instance of failure on the part of the railroad companies to fully and completely comply with and carry out the instructions of the Board of Public Utility Commissioners relative to the proper

construction of highway and trail crossings and the safeguarding of the interests of the traveling public.

For the Director:

E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,
HIGHWAY ENGINEER,
SENIOR SUPERVISING ENGINEERS,
DEPARTMENT ENGINEER, Mindanao and Sulu, and
CITY ENGINEER, Baguio.

[Case No. 85.]

JUNE 22, 1914.

GENTLEMEN: You are hereby advised that after considerable discussion and after the hearing involving the question of the rules which should be observed in the construction and maintenance of grade crossings, the Board of Public Utility Commissioners has reached the conclusion that in the absence of special circumstances and conditions in the construction and maintenance of crossings of streets, roads, highways, trails, and farm crossings (all hereinafter designated as public or private highways) at grade by rail common carriers (hereinafter designated as railroads in the Philippine Islands), the following rules should be observed.

The public highways in the Philippine Islands are classed as:

First class.—Working surface generally 4 meters in width, the width depending largely on the traffic and use.

Second and third class.—Working surface generally 4 meters in width.

Trails.—Working width generally 1 meter in width.

The private highways are classed as farm crossing and trails:

Farm crossings.—These are generally 2 meters in width.

Trails.—These are generally 1 meter in width.

In the construction of railroad lines the grade line of the railroad shall, wherever reasonably possible, be so laid that the top of the rail shall coincide with the top of existing public highways.

Wherever it is found necessary for the railroad to change the surface of a public highway, either by lowering or raising it, the changed surface shall conform in width and construction to the surface of the public highway changed.

The new surface of the public highway shall be so constructed as to restore the same, as near as may be, to its former degree of usefulness; except that the changed surface shall be constructed level with the top of the rails of the railroad, inside of and for a distance of 3 meters outside of the rails measured along the center line of the highway; and from thence to a connection with the undisturbed surface of the public highway on a grade not exceeding 4 per cent unless the special permission of the Board is obtained therefor.

Highway crossings shall be planked solidly between the rails of the railroad (beveling the plank next to the running side of the rail for the wheel flange) and for a distance of 25 centimeters outside the rails; or, at the option of the railroad, plank 25 centimeters in width shall be used on each side of each rail of the railroad and the remainder not covered by plank between the rails, may be filled level with the top of the plank and rail by ballast or other suitable materials.

In all cases plank shall be securely fastened to the track ties of the railroad, and the width of the planking, measured at right angles to the center line of the highway, shall correspond to the width of the working surface of the highway.

Where it is necessary to cross existing private highways by a railroad the requirements specified for public highways shall be observed except that the rate of grade in descending or ascending to the old surface of the highway may, if reasonably necessary, be increased to 10 per cent, not exceeding the latter rate except by special permission of the Board.

Except in unusual cases, with the special permission of the Board, an unobstructed view of the railroad track shall be had for a distance of 400 meters along the track on either side of a public highway from points where the center line of the public highway intersects the outer boundaries of the railroad right of way.

Crossing signs on public highways and whistle posts along the railroad, both of approved design, shall be erected in conspicuous and proper places, except that, where approval is asked and obtained of the Board, crossing signs and whistle posts may not be erected at the crossing of designated trails.

Existing grade crossings that do not conform to all the requirements contained herein shall be brought in conformity thereto within one year from the date on which these rules are issued.

After construction all parts of the crossing shall be maintained at all times in first-class condition, particular care being taken to preserve the surface of the approach level with the planking and that no openings occur in which the feet of person or animals or the wheels of vehicles may be caught and cause injury or accident.

In the grading of railroads, where they are to cross highways, proper care shall be taken at all times to keep the highway in condition for safe and convenient use. Suitable temporary highway diversions may be permitted in proper cases to facilitate the construction

of a rail line. Tracks shall not be laid across a highway unless it is forthwith planked and, with the approaches thereto, placed in safe and convenient condition for use.

Notwithstanding the fact that under these rules one year is given to bring existing grade crossings into conformity herewith, the Board will at any time within that year, whenever necessary for the protection of the traveling public, require reasonable provision for the protection of such public at grade crossings. In other words the granting of the period of one year will not suspend the exercise of the jurisdiction of the Board conferred under the provisions of section 21, Act 2307. Furthermore, in the construction of all new grade crossings the provisions of section 20 of Act No. 2307 must always be observed.

By direction of the Board:

(Sgd.) C. C. MITCHELL,
Secretary.

MANILA, November 17, 1914.

Constructing Division Circular No. 153.

SIR: I have the honor to quote for your information the following communication received from the Executive Secretary:

"With reference to your indorsement of the 30th ultimo, on a communication of October 28, 1914, of the district engineer of Laguna, regarding the obligation of the laborers working for your Bureau to catch locusts, I have to quote, for your information, an indorsement of the 10th instant of the Attorney-General, which is self-explanatory:

"Respectfully returned to the Executive Secretary, Manila, P. I.

"In compliance with the request made in the attached indorsement hereon in which an opinion is requested as to whether laborers employed at a daily wage by the Bureau of Public Works at the quarry of Los Baños, Laguna, are exempt from the locust duty under the provisions of Act 834, the undersigned has to state the following:

"Section 1 of said Act 834 provides partly as follows:

"'Nothing in Act Numbered Eight hundred and seventeen, entitled 'An Act declaring * * *, and authorizing and providing for the appointment of a board in each province with full powers to call upon all able-bodied inhabitants thereof to take united action to suppress the pest, and for other purposes,' shall require the services in the suppression of the locust pest of officers or men of the Army or Navy of the United States, civil employees of the United States Government, officers or employees of the Insular Government, or the officers or servants of companies or individuals engaged in the business of common carriers on sea or land, or priests, ministers of the Gospel, physicians, practantes, druggists, or practantes de farmacia actually engaged in business, or lawyers when actually engaged in court proceedings."

"The laborers above referred to, being employed by the Bureau of Public Works, it is only necessary to determine whether they may be considered as employees of the Insular Government under the provisions of the section above quoted. That they are at least laborers of the Insular Government may be easily inferred from the fact that they are employed by and are directly responsible to the Bureau of Public Works, which is a branch of the Insular Government.

"As a general rule the term "employees" means a person who is employed or one who works for wages or a salary, and is usually applied to clerks, workmen, laborers, etc., and even day laborers (3 Words and Phrases, page 2369, and cases cited; 15 Cyc., 1032). On the other hand it has also been held that the term "laborer" is no more comprehensive than the term "employee," and that it does not include a more extensive class or services than such work. (3 Words and Phrases, 2369, and cases cited.)

"The law, as may be seen in the section above quoted, in exempting employees of the Insular Government from the duty in question does not make any special reference to a particular class or classes of employees rendering services for the Insular Government, and it would be but reasonable to conclude that the term "employee," used in said section, includes not only clerks or other employees, but also laborers employed by any branch of the Insular Government, such as those engaged by the Bureau of Public Works at the quarry of Los Baños, Laguna, as mentioned in the attached indorsement hereon.

"This view is consistent with what seems to be one reason for the exemption provided for by said Act 834. If officers and other employees of the Insular Government are exempted from the duty of rendering services in the suppression of locusts in a locality, it must be partly for the reason that as required by public interest, the services due to the Government should be given preference and not interfered with by the performance of other compatible services. This being so, no reason can be found why laborers employed by the Bureau of Public Works, whose services are as necessary to the Government as those of other employees, should not work under their employment entirely free from the duty of aiding in the suppression of locusts under provisions of the Act herein referred to."

"Very respectfully,

"IGNACIO VILLAMOR,
"Executive Secretary."

Under this decision of the Attorney-General, laborers employed on public works cannot be required to leave such work and their services utilized in the suppression of the locust pest.

The importance of fighting locusts should not, however, be overlooked, and when laborers can be conveniently spared from public works they should unite with other inhabitants of the province in suppressing the pest.

As to whether the services of Government laborers are required, in the interest of the public, on public works in preference to other compatible services, is a matter left to the judgment and discretion of the district engineer.

Very respectfully,

WARWICK GREEN,
Director of Public Works.

To all DISTRICT ENGINEERS,
HIGHWAY ENGINEER,
SENIOR SUPERVISING ENGINEERS,
DEPARTMENT ENGINEER, Mindanao and Sulu, and
CITY ENGINEER, Baguio.

MANILA, P. I., November 27, 1914.

Constructing Division Circular No. 154.

SIR: You are directed to make up, from what information may be readily available, a list of the important buildings in your territory which have been constructed since 1898. Also that you show their approximate location on a map of the province to be submitted with the report. If you are doubtful whether a building

may be considered important, the line may be drawn at ₱2,500, giving due credit for voluntary labor, etc.

Buildings which have been comprehensively rebuilt are to be included, if the new work amounts to more than 50 per cent of their present value. If the year of completion of approximate present value of any building is readily available it should be noted. The list should include buildings in which the walls are constructed of a good quality of native lumber, together with those built of more durable materials. It should include municipal, provincial, and Insular buildings.

This information is to be used on the map which the Bureau is now making for the local Panama-Pacific Board. It is to show achievements in public works since 1898. It should be understood that it is not desired that lengthy searches of records and accounts be made in order to produce the building list. Your own familiarity with the territory, aided by conference with the provincial officials, will insure that no important item is omitted.

This list, together with the road diagram for December 31, 1914, should be forwarded from your office not later than December 15, 1914. The diagram is to be used for the same purpose as the list

For the Director:

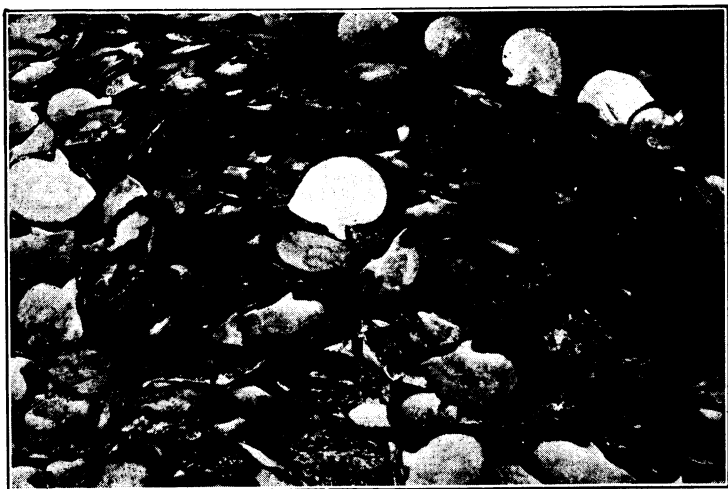
E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,
HIGHWAY ENGINEER,
SENIOR SUPERVISING ENGINEER,
STRUCTURAL ENGINEER,
DEPARTMENT ENGINEER, Mindanao and Sulu, and
CITY ENGINEER, Baguio.

APPENDIX B.

MOTOR VEHICLES REGISTERED AT THE BUREAU OF PUBLIC WORKS, MANILA, P. I., FROM SEPTEMBER 26 TO DECEMBER 24, 1914, INCLUSIVE.

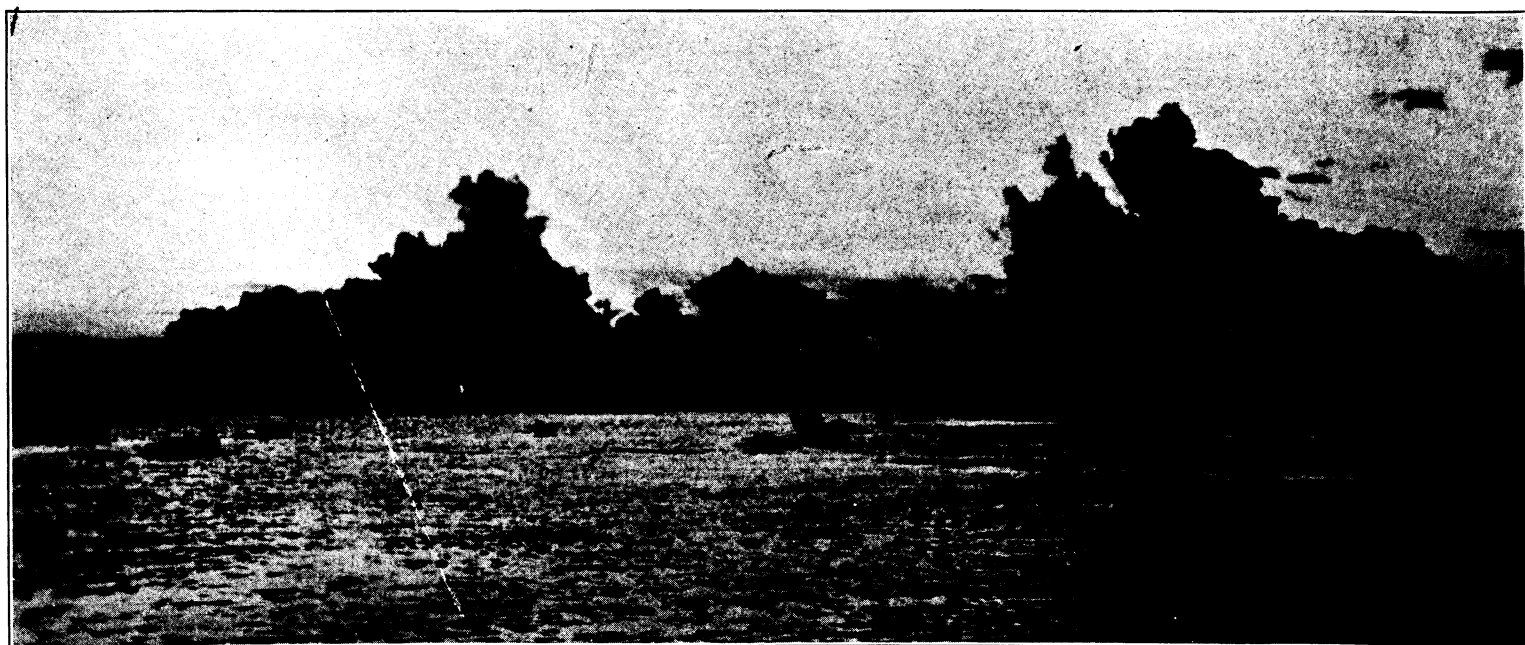
Registry No. and type.	Owner's name.	Registry No. and type.	Owner's name.
3226. Truck.	Compañia La Union, Tacloban, Leyte.	3317. Motorcycle.	G. E. Knapp, Supreme Court, Manila.
3227. Automobile.	Mrs. G. A. Preston, 704 Wright, Manila.	3318. Tricycle.	H. Fleischer, Dumaguete, Oriental Negros.
3228. do.	Compañia La Union, Tacloban, Leyte.	3319. Motorcycle.	La Insular Cigar Factory, Manila.
3229. do.	A. R. Roxas, 231 Gral. Solano, Manila.	3320. do.	C. Jefferson, Camp McGrath, Batangas.
3230. do.	R. R. Hidalgo, 677 Tanduay, Manila.	3321. do.	F. M. McClofin, Fort McKinley, Rizal.
3231. do.	G. R. Harvey, Manila Hotel, Manila.	3322. do.	La Union Co., Tacloban, Leyte.
3232. do.	F. Infante, Valladolid, Occidental Negros.	3323. do.	J. V. Else, care of A. S. Watson Co., Manila.
3233. do.	S. Richmond, Albay, Albay.	3324. do.	J. Jennings, Camp McGrath, Batangas.
3234. do.	Luis R. Yanco, Manila.	3325. do.	G. P. Chase, Medical Supply Co., Manila.
3235. do.	C. I. Williams, 30 Alix, Manila.	3326. do.	T. A. Matsdario, Camp Stotsenberg.
3236. do.	E. de los Santos, Malolos, Bulacan.	3327. do.	J. Gonzaga, Bacolod, Occidental Negros.
3237. do.	Maj. J. L. Knowlton, Army and Navy Club, Manila.	3328. do.	J. Spring, Zamboanga, Mindanao.
3238. do.	Henry S. Greenleaf, Army and Navy Club, Manila.	3329. do.	Province of Albay.
3239. do.	Maj. R. B. Grubbs, Army and Navy Club, Manila.	3330. do.	A. Owens, Fort McKinley, Rizal.
3240. Delivery.	Rueda Hermanos & Co., Manila.	3331. do.	Philippine Constabulary, Manila.
3241. Automobile.	F. O. Smolt, 2 Isla Romero, Manila.	3332. Assigned to motor-	
3242. do.	G. Baldwin, care of Vacuum Oil Co., Manila.	to cycles.	
3243. do.	E. Schimming, 2 San Sebastian, Manila.	3399. do.	
3244. do.	W. W. Weston, 325 Antipolo, Manila.	3400. Automobile.	F. E. Foster, 714 Pennsylvania, Manila.
3245. do.	T. Zavalla, Santa Rosa, Laguna.	3401. do.	J. R. Shook, Delmonico Hotel, Manila.
3246. do.	J. Andrews, Iloilo, Iloilo.	3402. do.	Maj. A. G. Jenkins, U. S. Army, Manila.
3247. Truck.	Fabrica de Hielo de Manila, Manila.	3403. Delivery.	A. Cu-Joco, Laoag, Ilocos Norte.
3248. do.	Do.	3404. Automobile.	Dr. V. Panlilio, Mexico, Pampanga.
3249. Automobile.	G. Reyes, Lucena, Tayabas.	3405. do.	M. de los Reyes, Caloocan, Rizal.
3250. Police patrol.	Municipality of Iloilo, Iloilo.	3406. do.	Wm. H. Steinman, Los Baños, Laguna.
3251. Fire engine.	Do.	3407. do.	P. F. Acosta, San Nicolas, Ilocos Norte.
3252. Automobile.	J. C. Graham, Los Baños, Laguna.	3408. do.	Maj. H. Hall, U. S. Army, Manila.
3253. do.	Damaso Sempio, San Miguel, Bulacan.	3409. do.	Mrs. A. Rocuant, 980 M. del Pilar, Manila.
3254. do.	J. W. A. Redhouse, 413 Dakota, Manila.	3410. do.	Segundo Feriols, 660 Echague, Manila.
3255. do.	Theo. Nickelsen, Manila Hotel, Manila.	3411. do.	F. Leonson, 2293 Juan Luna, Manila.
3256. do.	M. Quintos, 1175 M. del Pilar, Manila.	3412. do.	Do.
3257. do.	Capt. E. W. Clark, 644 Herran, Manila.	3413. do.	Rosario Vizcarra, 303 T. Alonso, Manila.
3258. do.	Carlos P. Rubio, 204 San Luis, Manila.	3414. do.	John Canson, 665 Gral. Luna, Manila.
3259. do.	R. H. Gill, Jolo, Mindanao.	3415. do.	Mariano Cui, 1134 M. del Pilar, Manila.
3260. do.	J. Arroyo, Iloilo, Iloilo.	3416. do.	Maj. Van Dusen, Camp Stotsenberg, Pampanga.
3261. do.	V. Monroy, 228 Plaza Santa Cruz, Manila.	3417. do.	V. Madrigal, 285 Aviles, Manila.
3262. do.	F. Tanjutko, Hagonoy, Bulacan.	3418. do.	F. Buencamino, jr., 2229 Azcarraga, Manila.
3263. do.	A. Icasiano, Hagonoy, Bulacan.	3419. do.	W. T. Beardsley, Manila Hotel, Manila.
3264. do.	P. E. E. Meller, 800 Wright, Manila.	3420. do.	F. Lopez, Lucena, Tayabas.
3265. do.	L. del Castillo, Sarabia, Occidental Negros.	3421. do.	Lieut. Col. G. O. Cress, Fort McKinley, Rizal.
3266. do.	Roy J. Berry, 223 Gral. Luna, Manila.	3422. Truck.	P. Medina, Rosario, Cavite.
3267. do.	R. A. Reyes, 305 Misericordia, Manila.	3423. Automobile.	L. L. Fischback, 1016 Carolina, Manila.
3268. do.	M. Velasco, 333 Soler, Manila.	3424. do.	C. G. Thompson, care of Bureau of Prisons.
3269. do.	G. Lichauco, 436 Tanduay, Manila.	3425. do.	V. Sanchez, 360 Aviles, Manila.
3270. do.	Cesar Ledesma, Silay, Occidental Negros.	3426. do.	J. de Garchitorena, 40 Escolta, Manila.
3271. do.	H. Yulo, Bago, Occidental Negros.	3427. do.	I. C. Perez, 710 Magdalena, Manila.
3272. do.	J. Ledesma, Silay, Occidental Negros.	3428. do.	J. C. Rockwell, 715 Peñafrancia, Manila.
3273. do.	B. de Guzman, Umingan, Pangasinan.	3429. do.	Olimpia, C. Cruz, Malolos, Bulacan.
3274. do.	P. Peralte, 21 A. Sixto, Manila.	3430. Truck.	Domingo Olivan, Bulan, Sorsogon.
3275. do.	E. C. McCullough & Co., Manila.	3431. Tractor.	Leyte Land Transportation, Tacloban.
3276. do.	R. J. Fernandez, 103 San Rafael, Manila.	3432. Automobile.	C. Pineda and A. Tantoco, Malolos, Bulacan.
3277. do.	Mrs. M. Meadows, 770 Alix, Manila.	3433. Ambulance.	Medical Department, U. S. Army, Manila.
3278. do.	Philippine Carnival Association, Manila.	3434. Automobile.	M. Teague, 139 Magallanes, Manila.
3279. do.	N. T. Deen, Cebu, Cebu.	3435. do.	John S. Hord, 242 Vito Cruz, Manila.
3280. Truck.	Manuel Matias, Ligao, Albay.	3436. do.	Jose Arnaiz, 502 Salcedo, Manila.
3281. Automobile.	W. G. Hogle, 984 Singalong, Manila.	3437. do.	M. de Lichauco, 436 Tanduay, Manila.
3282. do.	J. M. McDowell, Los Baños, Laguna.	3438. do.	W. G. Stevenson, care of Stevenson & Co., Manila.
3283. Truck.	Leyte Land Transportation, Tacloban.	3439. do.	Vicente Monroy, 228 Plaza Santa Cruz, Manila.
3284. do.	Do.	3440. do.	Roy J. Berry, 223 Gral. Luna, Manila.
3285. Automobile.	Dr. F. F. Wing, U. S. Army, Manila.	3441. do.	Lieut. C. Telford, Fort McKinley, Rizal.
3286. do.	M. Locsin, Silay, Occidental Negros.	3442. do.	A. M. Opisso, 2 Ululi, Manila.
3287. do.	J. J. Fox, Tagudin, Mountain Province.	3443. do.	C. I. Williams, 30 Alix, Manila.
3288. do.	Yebana Cigar Factory, Manila.	3444. do.	Sultan of Sulu, Jolo, Mindanao.
3289. do.	F. R. Day, 644 Herran, Manila.	3445. do.	Do.
3290. do.	Col. J. T. Knight, Land Transportation, Manila.	3446. do.	Silver Dollar, Plaza Garage, Manila.
3291. do.	B. Natividad, Arayat, Pampanga.	3447. do.	Capt. P. A. Murphy, U. S. Army, Manila.
3292. do.	Sra. Adela L. de Mapa, Iloilo, Iloilo.	3448. do.	Lieut. A. W. Smith, U. S. Army, Manila.
3293. do.	V. Quiogue, Avenida Rizal, Manila.	3449. do.	Maj. C. R. Darnall, U. S. Army, Manila.
3294. do.	B. Guidte de Zarate, 791 Echague, Manila.	3450. do.	Bernard Meyer, 62 Bustillos, Manila.
3295. do.	F. J. Teulon, 803 Georgia, Manila.	3451. do.	Francisco T. Ramos, Himamaylan, Occidental Negros.
3296. do.	J. C. Graham, Los Baños, Laguna.	3452. do.	C. Halden, 9 Duran, Iloilo.
3297. do.	M. Hojilla, Silay, Occidental Negros.	3453. do.	Venancio Menses, Bulacan, Bulacan.
3298. do.	R. Perez Siguenza, Silay, Occidental Negros.	3454. do.	J. Quintos, 1175 Real, Malate, Manila.
3299. do.	A. Campos, Pontevedra, Occidental Negros.	3455. Truck.	D. Ordoeza, Santa Cruz, Laguna.
3300. Motorcycle.	H. Osborne, U. S. Naval Station, Cavite.	3456. Automobile.	V. Litiato, 950 Azcarraga, Manila.
3301. do.	A. Sabater, 90 Real, Walled City, Manila.	3457. do.	J. Manapat, Maypajo, Rizal.
3302. do.	C. A. Robertson, 681 Alix, Manila.	3458. Truck.	J. A. Murphy, Iligan, Mindanao.
3303. do.	A. S. Smith, Regan Barracks, Albay.	3459. Automobile.	W. S. Stevenson, 105 Manga, Manila.
3304. do.	J. F. Russel, Capiz, Capiz.	3460. do.	F. Leonson, 2259 Juan Luna, Manila.
3305. do.	Province of Zamboanga, Mindanao.	3461. do.	Lieut. L. A. Falligans, Fort McKinley, Rizal.
3306. do.	Bureau of Constabulary, Manila.	3462. do.	Frank Smith, San Fernando, Union.
3307. do.	M. Smith, Capiz, Capiz.	3463. do.	H. Carson, Baguio, Benguet.
3308. do.	E. Natividad, Cebu, Cebu.	3464. do.	V. Racela, Lucena, Tayabas.
3309. do.	M. T. Borja, 731 Dart, Manila.	3465. do.	A. P. Cu-Joco, Laoag, Ilocos Norte.
3310. do.	J. G. Owen, 1261 Real, Malate, Manila.	3466. do.	L. G. Dawson, Iloilo, Iloilo.
3311. do.	George Barbers, Cabuyao, Ilocos Sur.	3467. do.	Francisco Leonson, 2259 Juan Luna, Manila.
3312. do.	Province of Cagayan.	3468. do.	Juan Barrameda, Baao, Ambos Camarines.
3313. do.	R. Janssen, 636 Isaac Peral, Manila.	3469. do.	Hon. Vivencio del Rosario, Manila.
3314. do.	A. W. Fluemer, Isla de Provisor, Manila.	3470. do.	A. Vergel de Dios, Baliuag, Bulacan.
3315. do.	H. L. Brown, Dumaguete, Oriental Negros.	3471. do.	Juan Zamonte, Malabon, Rizal.
3316. do.	P. Rodriguez, 336 Asuncion, Manila.	3472. do.	Lieut. C. W. Russell, Army and Navy Club, Manila.



A pile of 12 tons of pearl shell belonging to pearler "Langford," in a warehouse at Zamboanga.



Tapping a Ceara rubber tree on Doctor Strong's plantation at Isabela de Basilan. First tapping of rubber in the Philippine Islands.



A sunset, taken from the wharf at Zamboanga.

APPENDIX C.

PROJECTS ACTIVE OCTOBER 1, 1914.

Provinces.	Roads and trails.				Bridges and culverts.				Provincial administration buildings.		Municipal administration buildings.		Prisons.		Schools.				Construction and operation.																	
	Construction.	Maintenance.	Repair.	Reconstruction.	Construction.	Maintenance.	Repair.	Reconstruction.	Construction.	Maintenance.	Repair and alteration.	Construction.	Reconstruction.	Maintenance.	Construction.	Repair and alteration.	Maintenance.	Construction.	Maintenance.	Repair and alteration.	Reconstruction.	Markets.	Parks, grounds, and athletic fields.	Miscellaneous buildings.	Ferries.	Water systems.	Record vaults.	Quarries.	Telephone lines.	Electric-light plants.	Miscellaneous.	Total.				
Albay	3	2			5						1							7	1			5	1	1						2	28					
Ambos Camarines	12	2		2	6	1							1					3					1	2								2	36			
Antique	3	2			3													1														2	11			
Bataan	1	2		2	1													7	2		1	2	1	4		1						2	8			
Batangas	6	5			2	1		1			1		1					7				2				1						2	37			
Bohol	1	3		2	6													1														1	14			
Bulacan	4	3																3				2		1									4	13		
Cagayan	2	2		1		1					1							1						1	1								1	15		
Capiz	3	2		1	1						1							5	1				1		1								2	18		
Cavite	6	2			1													2															2	13		
Cebu	7	2	1			1												3				5		4		1							3	27		
Ilocos Norte		2			1							1						7					3											4	14	
Ilocos Sur	13	3	1		3	1							2					13			2		1	1	1								3	41		
Iloilo	5	4	2		2		2											1						2										4	27	
Isabela	3	4			3	1												1							1									1	14	
Laguna		3	1	1	1			1										6				3	1											1	14	
La Union	7	4			2													3					1	3											1	14
Leyte	2	2			3													2																	1	14
Misamis	2	3			3													7					1	1		1	1							1	14	
Nueva Ecija	2	3			3													3					2	1										2	14	
Occidental Negros	8	2		2	2													5					3				2							2	24	
Oriental Negros	3	4			3						1							4							1									1	14	
Pampanga	2	3			1			1							2	5		8			1	10	2		2	1								9	58	
Pangasinan	5	4		2	7													1			1	1		7										1	24	
Rizal	2	6			2	1					1							5				1	1	1										3	18	
Samar	2	4		1														2																5	15	
Sorsogon	3	2			3													4			3														11	11
Surigao	2	2																3																	2	13
Tarlac	1	3									1							3					3												15	15
Tayabas	1	3									1							3					3	1	1		1								2	14
Zambales		2			9													1																		14
Total	111	98	5	14	84	7	2	3			7	1	4	8				120	6	6	3	46	12	28	8	8			2	1	54		638			

The 54 projects under the caption "Miscellaneous" represent 18 surveys and investigations of roads, bridges, water systems, rivers, etc., 4 dikes, 3 wharves, 3 harbor maintenance, 2 river controls, 1 irrigation system, 1 auto line, etc.

BUREAU OF PUBLIC WORKS

ORGANIZATION

WARWICK GREENE, *Director of Public Works*

G. C. FENHAGEN, *Consulting Architect*

W. L. GORTON, *Chief Designing Engineer*

H. F. CAMERON, *Senior Supervising Engineer, Mindanao and Sulu*

C. LINDSEY, *Assistant to the Director*

WILLIAM HIRZEL, *Chief Accountant*

O. K. OLESON, *Property Clerk*

A. K. JONES, *Law Clerk*

L. L. COOK, *Superintendent of Automobiles*

JOSE VENTANILLA, *Record Clerk.*

CONSTRUCTING DIVISION

E. J. WESTERHOUSE, *Chief Constructing Engineer*

C. E. GORDON, *Highway Engineer*

D. E. HENRY (absent), *Senior Supervising Engineer*

J. W. VICKERS, *Superintendent Artesian Wells*

DISTRICT ENGINEERS

Brown, E. C.....	Albay, Albay	Barry, J. R.....	Los Baños, Laguna
Dandois, Chas. S.....	Naga, Ambos Camarines	Clark, L. T.....	Tacloban, Leyte
Segura, Valeriano.....	San Jose, Antique	McGregor, J.....	Manila
Williams, A. D.....	Baguio, Benguet	Allen, R. N.....	Cagayan, Misamis
Francisco, Luis.....	Balanga, Bataan	Austin, A. W.....	Cabanatuan, Nueva Ecija
Caton, J. H. 3d.....	Batangas, Batangas	McGlathery, S. L.....	Bacolod, Occidental Negros
Harrison, J. L.....	Malolos, Bulacan	Grosvenor, I. R.....	Dumaguete, Oriental Negros
Bogges, L. S.....	Tagbilaran, Bohol	Halsema, E. J.....	San Fernando, Pampanga
Barry, R. L.....	Tuguegarao, Cagayan	Morrison, C. G.....	Lingayen, Pangasinan
Bennett, C. R.....	Cavite, Cavite	Brown, L. R.....	Pasig, Rizal
Sjovall, A. H.....	Capiz, Capiz	Baugh, N. R.....	Catbalogan, Samar
Russell, Claud.....	Cebu, Cebu	Lilley, H. B.....	Sorsogon, Sorsogon
Glenn, R. V.....	Iloilo, Iloilo	Meehleib, H. R.....	Surigao, Surigao
Baluyot, Sotero.....	Laoag, Ilocos Norte	Agcaoli, Romarico...	Tarlac, Tarlac
Smith, E. D.....	Vigan, Ilocos Sur	Sylvester, A. T.....	Lucena, Tayabas
Gomez, Pastor.....	Ilagan, Isabela	Vallarta, Julian.....	San Narciso, Zambales
McComb, D. Q.....	San Fernando, La Union		